PART XII.

THE RIVER FISHERIES OF THE ATLANTIC STATES.

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PART XII.

THE RIVER FISHERIES OF THE ATLANTIC STATES.

1.—THE RIVERS OF EASTERN FLORIDA, GEORGIA, AND SOUTH CAROLINA.

By Marshall McDonald.

1. SAINT JOHN'S RIVER, FLORIDA.

Description of the river.—The extreme sources of the Saint John's River lie south of the twenty-eighth degree of north latitude. It trends north and south, and, gathering accessions from a hundred lakes, finally discharges its waters into the Atlantic Ocean under latitude 30° 30′. Its general course is from south to north. Like the Gulf Stream, therefore, it carries the warmth of the south to colder latitudes, in which respect it differs entirely from the other principal streams of the Atlantic slope, all of which run south and east, having their sources north, among the mountains, and carrying down to their lower reaches water of a lower temperature than that of the surrounding locality. This is especially true in the spring and early summer, when we find the temperature of these streams progressively diminishing as we ascend to their headwaters. The data are not at hand to furnish a tabular statement in proof of this progressive rise of temperature as the headwaters of the Saint John's are approached, because records are only kept at one point—Jacksonville; but the course of the river from south to north clearly shows that such must be the case. From the records of the signal office at Jacksonville we have obtained a connected series of observations* of the temperature of the river for the years 1873–'74, 1877–'78, 1878–'79, and 1879–'80.

An examination of these tables shows that the river temperature passes below 60° about the 1st of December, not again rising above that degree until the middle or end of February.† Coincident with this period of low temperature the shad run begins, the fishing season being at its height in February, when the temperature reaches 60°. A comparison of these observations with those for other rivers shows that though the shad season on the Saint John's differs widely in time from that on more northern streams, yet it occurs under similar conditions of water temperature; in other words, the time of the occurrence of shad in any river appears to depend solely upon the

* For tables see Section I, Natural History of Aquatic Animals, pp. 600, 601.

† In 1871 William Dempsey bought shad at New Berlin, on the Saint John's. He found that the average monthly catch per net was, in December, 82.6; in January, 413; in February, 619; and in March, 207. This indicates that from the latter part of January to the end of February is the period of the greatest abundance of shad in this river.

relative temperature of the water. The shad ascend to the very sources of the Saint John's, there being no obstructions, and spawn in Lake Monroe, distant several hundred miles from the Atlantic.

METHODS EMPLOYED IN THE SHAD FISHERY.—In this river the shad is the only fresh-water species which is the object of organized fisheries. The principal salt-water fisheries are discussed by Mr. R. E. Earll in his account of the salt-water fisheries of the Florida coast. From Palatka down the shad fisheries are prosecuted entirely with gill-nets. On Lake Monroe are three small hand-seines.

The shad caught in the Saint John's are either sold fresh to supply local demand, or are packed in ice and sent to Northern markets. Savannah is the principal point to which shipments are made. There the fish are rehandled and reiced, and then sent by steamer and rail to the interior towns of the South Atlantic States or to the Northern cities. Probably three-fourths of the entire catch is so distributed. No definite number of shad makes a package, which usually consists of a rice or other convenient barrel or box, the largest being selected when possible, in order to save freight.

MR. EARLL'S ACCOUNT OF THE FISHERY.—Mr. Earll gives the following historical data in regard to the fisheries of the Saint John's:

"Shad were first caught at Mayport by Charles Waterhouse, of Connecticut, in 1858. He had previously fished in the Savannah, but abandoned it on account of poor results. At Jacksonville gill-nets were first used in the shad fisheries in 1868. At Palatka, C. B. Smith, of Connecticut, was the first to establish a shad fishery. He began the work in 1872, and it was not until 1877 that a second fishery was started. In the year 1873, 94,000 shad were caught at New Berlin with thirty nets (an average of 3,133 to the net). From 1865 to 1875 the average catch was 25,000 to the net. The year 1876 was the most prolific season of all, when each net averaged a catch of 5,000. In 1875, at Palatka, one net caught 11,000 shad, and in the same year it is said six nets took 55,000."

Dr. Charles Kock, in a letter from Jacksonville dated January, 1874, says: "From the bar at the mouth of the Saint John's River up to Palatka seventy-five to eighty nets are fished during the shad season. These nets are about 200 yards long and 10 feet deep (the mesh 1½ inches square), and are set in from 10 to 12 feet of water. In 1874 the product of the shad fisheries amounted to 250,000 shipped or consumed. The average price at Jacksonville, season of 1872–'73, was 15 cents *apiece*."

MR. GOODE'S ACCOUNT OF THE FISHERY.—The following interesting description of the shad fisheries of the Saint John's River, from the pen of Mr. G. Brown Goode, is inserted entire:

"The shad is next to the mullet the most important fish of East Florida. The Saint John's seems to mark its southern limit of distribution, though within the past few years it has been acclimated by the efforts of the United States Commissioner of Fisheries in trans-Mississippi and several other waters emptying into the Gulf of Mexico. It has been claimed by many persons that the shad has not inhabited the Saint John's River until within a few years past. This has been clearly shown to be a mistake, arising from the fact that during the war no fishing was carried on, and that before the war local enterprise was not sufficient to develop the industry. Col. H. S. Sammis, of Arlington, and other early settlers remember the capture of shad in the Saint John's as early as the year 1840. Mr. Waterhouse had one or two nets at Mayport about 1861, and is said to have met with good success. About 1865 and 1866 Mr. Remps and others began fishing, and since 1870 the fisheries have been constantly on the increase. There are shad also in the Saint Mary's River, though no effort is made to capture them. The Saint John's River shad are not so

large as those of the Connecticut, the average weight being 3 or 3½ pounds. In 1874 I was told that they sometimes weighed 6 pounds, in 1878 that they never exceeded 5. Has there been a falling off in size? They are rather higher in body than the Northern shad, but are in no wise less plump and delicate in flavor. Like most Southern shad, they have black-tipped caudal fins. I ate shad caught at Jacksonville April 15, 1878, and in spite of the warmth they were fully as hard and sapid as the best May fish from the Connecticut, just from the seine.

"The season of 1877–'78 was unusually long in the Saint John's. The first shad was taken November 20, 1877, and they were in market in some numbers at Thanksgiving. December 15 shad fishing was at its height. April 15 shad were still in fine condition, though the nets were taken out about this time. In 1874 the first was taken November 10, in 1876 December 1. In 1874 the fishing continued till June 1.

"The spawning time is apparently from the middle of March to the latter part of April. March 20, 1875, and April 15, 1878, showed mother fish in fine full roe, almost ready to spawn. I am told that the fishing continues a week or two later farther up the river at Lake Monroe. The fishermen say that the shad spawn at the very head of the river, but I have no doubt that many deposit their eggs on convenient grounds nearer the sea. The fishermen also have a notion that shad that have well ascended the river never return, for they say that they have never known a spent fish. This they account for by the theory that they are devoured by alligators and catfish, the shad being weak and helpless after spawning. The young fish, they tell me, are seen in large schools along the banks in summer and autumn, descending to the sea.

"The shad fishery is carried on entirely with gill-nets. These nets are 4½ to 5 inch mesh, usually scant 5 inches, 45 to 50 meshes deep and 300 to 500 fathoms in length. They are made in Boston and cost from $100 to $125 each, fitted for use. The boats are center-board sail-boats, about 15 feet long, with movable mast and sprit sail. They are built at the mouth of the Connecticut River, and cost about $60 each.

"The nets are heavily leaded; the leads weigh 2 ounces each, and are placed 2½ feet apart. Formerly they were placed 6 feet apart.

"The fishermen are principally Northern men from Cape Ann, Connecticut, and Delaware Bay, who come south expressly for this shad-fishing. From sixty to one hundred of these men come down every winter. They camp out in tents or shanties conveniently situated to the various reaches along the river.

"The nets are allowed to drift with the current; they are set directly across the river, and drift broadside to, one end being buoyed, the other retained in the boat.

"There were about eighty shad-nets operated on the Saint John's at the date of my last visit, in April, 1878. Of these Kemps, Mead & Smith, of Jacksonville, owned twenty-five, receiving also the proceeds of four independently owned. John Buckle, of New Berlin, owned seven, and received the fish from eight fishermen who owned their own nets and boats. The Mayport Fish Company, Mr. L. S. Burroughs agent, runs four nets, and there are also eight or nine independent fishermen at the bar who own their own gear. There are said to be one or two nets at Lake Monroe. Kemps, Mead & Smith work their nets in all the reaches from Mayport to Palatka; Melton & Co. from Mayport to Jacksonville; Mr. Buckle and the other New Berlin fishermen from Mayport to New Berlin; and the Mayport fishermen from Mayport almost to New Berlin.

"Between Mayport and Jacksonville are seven reaches or long stretches of river suitable for drifting with the shad-nets. They are (1) the Mayport Reach, about a mile long; (2) the Sisters Reach, 2 miles long; (3) Saint John's Reach, under Saint John's Bluff, half a mile long; (4)

Shipyard Reach, three-fourths of a mile long; (5) Clapboard Reach, 1 mile long; (6) Yellow Bluff Reach, half a mile long; and (7) Baxter's Reach, 7 miles long, from Reddy's Bluff to Jacksonville.

"The nets are worked both on the ebb and flood tide, though the latter is preferable, from the fact that the fish ascending the stream 'gill' easily in the net drifting in the opposite direction, while the net floating behind them with the flood overtakes them with difficulty. Sometimes the boats make two drifts on one tide, sailing back a second time to the head of the reach. Often there are many nets on one reach. In this case they take turns, the first set belonging to the boat which first gains the head of the reach.

"Averaging the eighty nets at 2,500 shad each, which seems to be a fair estimate in the opinion of Mr. Kemps, Mr. Buckle, Mr. Balsam, and Mr. Kelly, of New Berlin, we have the estimated yield of 200,000 shad for the Saint John's for the season of 1877–'78. The results of the previous season, 1876–'77, obtained by a similar method, probably did not fall much below 280,000, while 1875–'76, 1874–'75, and 1873–'74 the yield was about 160,000 or less.

"Mr. Yate estimated independently that the catch of 1877–'78 amounted to 200,000, and that of 1876–'77 100,000 additional.

"Melton & Co. handled about 80,000 shad in 1877–'78, of which about 20,000 were sent north. In 1876–'77 they handled about 120,000. In 1875, at the time of my second visit to Florida, Mr. Melton estimated the quantity handled by him in the season just past, that of 1874–'75, at 125,000.

"Kemps, Mead & Smith handled, in 1877–'78, 35,000 to 40,000 shad; in 1876–'77 about 60,000, of which 40,000 were sent north. In my own judgment, the shipments to Northern markets in 1876–'77 cannot have fallen far short of 100,000 fish, and in 1877–'78 probably approximated 60,000.

"The fishermen who work the shad-nets are employed on shares, the boat and net being furnished by the fish dealers, the fishermen receiving from 8 to 12 cents for each shad they catch. Ten cents is perhaps a fair average rate. The most successful net at New Berlin in 1878 took 4,000 shad; the least successful, an old net worked by two negroes, took 900. The two fishermen netted in the first instance $200 each, in the last $45 each. The average profit in the last instance was probably $150, in 1878 not more than $100, a very meager return for four months' labor, after board bills, cost of fishing-clothes, and passage money are deducted.

"The cost of the fish to the dealers is rather hard to determine. The boats cost $60 and the nets $125. The boats last five or six years, the nets hardly more than one season. Allowing $15 for wear of boat and interest on its price, and $100 for the net, we find that, independent of their own subsisting and the cost of maintaining their establishments throughout the year, the actual cost of catching the fish, which falls to the share of the fishery capitalist, amounts to 4½ cents on each fish. Thus, at the very lowest estimate, the cost of bringing the fish from the water into the boats cannot fall much below 15 cents. These fish retail in the local markets for 25 cents each, small ones sometimes selling for 20. The cost of shipping to a Northern market is considerable. Let us take the extreme example of New York City. When shad are iced for the Northern markets they are packed in tierces which contain about 140 fish. To pack a tierce of fish properly requires 250 or 300 pounds of ice. Ice costs, perhaps, $12 per ton, bought from the Northern schooners. Allowing for waste, we will estimate the cost of ice for a tierce of fish at $2. The tierce is worth at least $1. Expressage to Savannah costs $3 on each tierce, and freight by steamer to New York $2. Thus, making no allowance for cartage or labor of packing, at the end of the route we must add $8 to the cost of a tierce full of shad, or 5 cents and 7 mills each. The cost of fish delivered in New York is 21 cents, and perhaps more. But then we must take into account the severe losses necessarily sustained by dealers in such perishable wares as

fresh fish. Thousands are often lost in a week, and the loss of one tierce materially lowers the profit on many others. In my own judgment, 40 cents would be a very small return, and perhaps 50 or 60 would be more equitable. Before the shad reaches the table of its final purchaser it must pass through the hands of two additional agents—the wholesale fishmonger and the retail dealer. It appears evident, then, that Florida shad must always be a luxury in the North. If the proposed improvements in the navigation of the Saint John's are ever effected, through lines of steamships to New York, with refrigerators built especially for transporting fish, would doubtless be sustained. In this event the cost of transportation would be much diminished, the cost of icing somewhat diminished, and the risk of loss entirely done away with. The fish would then reach their destination in excellent condition, and we may anticipate a very great reduction in their price. Forty or even 35 cents ought to remunerate the dealers, as well as double that price at the present time."

STATISTICS OF THE FISHERY.—The amount of capital invested in the shad fishery on the Saint John's in 1877 may be roughly estimated as follows:

	Value.
Seine-boats (80, at $50 each)	$4,000
Gill-nets (80, at $100 each)	8,000
Shanties, platforms, reels, fish-houses, &c	3,000
Total	15,000

The number of fishermen and shore hands does not probably exceed one hundred and seventy-five.

The total value of the shad fisheries for the four months and a half beginning December and ending April 15 may be fairly estimated at $50,000, allowing 25 cents to be the price at retail in Jacksonville. The actual cost of catching the fish has been shown to be 15 cents, allowing no profit and no risk-margin to the capitalists. The cost of taking the fish out of the water, then, is about $30,000.

Statistical summary of the fisheries of the Saint John's, Florida, for the season of 1880.*

Number of men employed	182
Amount of capital employed	$13,630
Product of the fisheries, in pounds (shad)	251,700
Value of product	$20,136

2. SAINT MARY'S RIVER.

Saint Mary's River lies between Florida and Georgia, and has its source in Okefenokee Swamp. From its size and character we would expect to find it abounding in extensive and valuable fisheries. Shad fishing, however, has met with only doubtful success, and no organized fresh-water fisheries have ever been prosecuted on the river. A considerable number of sturgeon are taken in the estuary, and find a market in Savannah. The statistics of capture and value are given in the discussion of the sturgeon trade of Savannah.

3. ALTAMAHA RIVER.

The shad fisheries of the Altahama seem to have been formerly much more productive than they are now. The migrations of the shad before there were any obstructions extended on the Oconee to some distance above Milledgeville. At the present day, although there is nothing to prevent their passage up to that place, they are rarely or never seen there.

* For details see Census Volume on *Fisheries*.

The organized fisheries are prosecuted exclusively with gill-nets, which are either floated with the tide or staked across where the fish run. Skim-nets and dip-nets are used at various points along the river, but the product thus obtained is insignificant, and we have no returns of it.

No regular fisheries exist above Doctor Town, at which point four men, fishing five gill-nets, take annually about 1,200 shad and 4,000 pounds of other fish. Parties from Brunswick, fishing for shad to supply the local market, take 3,000 shad and 6,000 pounds of other fish. At Darien, Ga., eleven men fish eleven nets. The product is 4,400 shad and 8,000 pounds of other fish, all of which goes to supply the local market.

The following summary will show how disproportionate to the magnitude of the river is the importance of its fisheries:

Number of men employed in the fisheries	49
Amount of capital employed	$2,900
Product of 1880, in pounds:	
Shad	30,100
Sturgeon	8[illegible],500
Mixed fish	38,000
Value of product	$10,123

Fully one-half of the fish taken and sold as shad are hickory-shad (*Clupea mediocris*).

The statistics of the important sturgeon fisheries at the mouth of the river are given in the chapter on the sturgeon trade of Savannah.

4. THE SATILLAS.

The Satillas traverse in their lower reaches an extensive region of alluvial swamp, which, by levees, has been converted into productive rice-fields. Both these rivers, like the Ogeechee, take their rise in the sandy belt which lies between tide-water and the Piedmont section of the South Atlantic States, the result being that they are never muddy, as are the Savannah or the Peedee. There are no obstructions to the ascent of fish. No organized fresh-water fisheries, however, exist except for sturgeon, which are taken immediately at the mouth and a short distance up the river. The product and value of the sturgeon fisheries will be given when treating of the sturgeon trade of Savannah.

5. THE OGEECHEE RIVER.

The Ogeechee River rises in the sandy belt of Georgia. Its waters, which drain through extensive swamps, are never muddy like those of the Savannah or Altamaha, nor, like them, is the stream subject to sudden floods and changes of temperature, which in the Ogeechee is higher than for the corresponding dates in the Savannah. This is to be explained by the fact that the former rises in the tide-water belt, instead of having its sources in the mountains.

As a result the run of shad and herring commences very early in the Ogeechee, and the fish mature their spawn at an earlier period than in the Savannah. So true is this that any one at all familiar with shad can, on seeing them exposed in the Savannah markets, tell at a glance, judging only by the degree of development, from which of these rivers they came. The run of shad begins in the early part of January and ends about the last of March.

The run of alewives, according to local report, begins about the 1st of March.

Although no permanent obstructions to the ascent of fish exist in the Ogeechee, only a small proportion of the fish which enter the river reach spawning-grounds, being excluded by the gill-nets, which are sufficient in number to almost totally block the way. To their agency must doubtless be attributed the very decided decline which has occurred in the last few years.

The principal object of the fisheries of this river are the shad and sturgeon. There seems to be a considerable run of *Clupea æstivalis* (locally known as English herring), but no organized fisheries exist for their capture. Most of the shad are caught in gill-nets, operated by gangs of men from Savannah, to which place the fish are shipped by carts or rail.

The following is a statistical summary of the fisheries of this river for 1880:*

Number of men employed	111
Amount of capital employed	$5,790
Product, in pounds:	
Shad	90,650
Sturgeon	88,500
Mixed fish	255,000
Value of product	$22,690

At some distance up the river quite a number of skim-nets, stake-nets, and dip-nets are used, but all the fish so caught go to supply the local demand, and we have no statistics of the product.

In the last two or three years pound-nets have been introduced into the river. The fish principally caught in them are rock and catfish, and, in their season, herring in large quantities, together with a few shad.

Extensive sturgeon fisheries exist in the estuary of the river, operated almost exclusively by fishermen from the Delaware. These fish are captured with gill-nets, and kept penned up until a sufficient number are taken, when they are slaughtered and sent by schooner to Savannah.

From local tradition we glean the following facts bearing on the shad fisheries of the Ogeechee. The run of shad is later than it used to be, and the fish have decreased materially in size. At the present day it is not worth while to put nets in the water until some time in February, while in former years, according to the fishermen, some fish were taken before Christmas. Formerly the catch per net in a night was from 200 to 280; now a net averages 15 or 20. On the other hand, fish which formerly sold for from 5 to 8 cents apiece now bring 25 cents and 30 cents apiece.

6. THE SAVANNAH RIVER.

DECREASE OF SHAD IN THE SAVANNAH.—The extreme sources of the Savannah are in Western North Carolina.

The records of the United States Signal Office show that the temperature of the river is higher at Savannah than at Augusta from August to May, but that during June, July, and August it is higher at Augusta. The winter temperature is usually about 45°, but it sometimes runs down to 40°. The data we possess, though not as accurate or as extended as we could desire, are sufficient to prove that there is a connection between the temperature of the water and the movement of the shad in the river. Thus much, at least, is certain, that shad do not enter the river till about the 1st of January, when the temperature is rising and is about 50° Fahr.

From the best available information on the subject the conclusion is reached that the Savannah shad fisheries do not now yield one-third the product they did eight years ago, and this decrease may be ascribed to the following causes:

First. The narrowness of the river. One familiar with the broad estuaries of the streams which flow into the Chesapeake remarks at once the extreme narrowness of these Southern rivers. Thirty miles from its mouth the Savannah River is not more than 400 or 450 yards wide, and as a result an amount of gill-net fishing that would have no effect in retarding the run of shad up the Potomac or Rappahannock is sufficient to almost completely obstruct the Savannah.

Second. The vast volume of muddy water which is always moving down, especially in the shad season. As a consequence no suitable spawning grounds exist on the lower portion of the

* For detailed statistics see Census Volume on Fisheries.

river, and the shad must ascend above Augusta to deposit their eggs. Seven miles above Augusta is the water-works dam, which prevents any further ascent; and the spawning grounds of this river are therefore practically confined to the 7-mile stretch from Augusta to the dam. Cooped up, as it were, in this area, the shad are entirely at the mercy of the innumerable traps and cast-nets that abound there.

In a word, the gill-nets permit but a small proportion of the shad which enter the river to reach their spawning grounds, and the appliances of capture in the vicinity of the dam take the rest. Instead of being surprised, therefore, that the shad fisheries have fallen off so greatly, we should rather wonder that the whole breed of fish has not been utterly extirpated.

Many years ago the shad pushed their annual migrations as far up as the Falls of the Talulah, a mountain tributary of the Savannah, where they were taken in some numbers. The height of the falls prevented further progress. Thence down to Augusta they were taken in very considerable quantities, and formed a very important food resource, being consumed fresh or salted away for winter use. The unrestrained and destructive modes of fishing pursued made their impression year by year upon the supply, which became greatly reduced, until the erection of the water-works dam, 7 miles above Augusta, cut off the run altogether.

Under the law authorizing the erection of this dam, sluices for the passage of fish were required to be left and kept open during the running season of the fish. Some shad were taken in 1879, 80 miles above. These necessarily passed through the openings in the dam. The calculated velocity of discharge through the sluices being upwards of 13 miles per hour, this fact furnishes a surprising exhibition of strength and boldness on the part of this fish.

THE SHAD SEASON.—The shad season begins at Savannah in the first half of January and ends about the last of March. It begins at Augusta in the middle of February and ends about the 10th of May, though shad are sometimes taken as late as July. This difference of more than a month between the season at Savannah and Augusta—180 miles above—shows an average rate of progress up the river of 6 miles a day. At this rate shad would reach Tallulah Falls about the 1st of April, and the season there would extend into July.

FISHING WITH TRAPS.—Between the water-works dam and Augusta, where the river descends by a series of falls or rapids a vertical distance of 45 or 50 feet, every favorable location is the site of a trap fishery—a mode of fishing which was formerly very productive, but is now considered no longer profitable. The traps are of three kinds: (1) the "fall" trap, or "slide," such as is in use in all our streams; (2) the "hack" trap, and (3) the square trap. The last two are essentially the same in principle, the only difference in construction being that the "hack" trap, instead of being square, has a V-shaped frame with its apex pointing upstream.

These traps are placed in strings or rows—from six to fifteen in a row—the intervals between them being occupied by a rough cribbing of logs filled in with stones. In 1879 there were about one hundred and ten of these traps between the dam and a point three miles below, and at several places they almost completely obstructed the channel of the river, so that it seemed impossible for a shad to run the gauntlet and reach the dam in safety. Fortunately, with a full river, which is frequent in the shad season, the traps are submerged, and fish may pass over them without much risk of capture.

FISHING WITH CAST-NETS.—Besides the traps in the rapids, a number of cast-nets are fished immediately under the dam. With clear water, so that the fish may be seen lying in the pools, this proves a very effective mode of fishing. I have seen six or eight shad taken at a single cast of the net. There was in 1880 an average of twelve cast-nets fished in the vicinity of the dam,

the catch varying from six to fifty in a day, according to the condition of the water and the good luck or skill of the fishermen.*

FISHING WITH HAUL-SEINES AND GILL-NETS.—The use of floating gill-nets is not practicable at any point above Augusta on account of the shoals and rapids of the river. Below that city the river is navigable for steamboats, and no traps are used. Haul-seines were formerly used at favorable locations all along the river for some 60 miles below Augusta. At Sand Bar Ferry, 5 miles below the city, was a noted fishery where the product each season bore no insignificant proportion to the entire catch of the river at the present time. These seine-shores are now abandoned, and the gillers gain a precarious subsistence by drifting in the empty seine berths.

Some short seines, gill-nets, and scoop-nets are fished all along the river in an irregular way for local supply, but the fishing for market is altogether with (float-seines) gill-nets. From Augusta to Johnston's Landing, 60 miles below, there were engaged in gill-net fishing, during the season of 1879, fifty nets and boats and one hundred men. The men are all native, about one-half being white. In most cases they own boats and outfit; but some receive their outfit from the dealers, to whom they agree to deliver their whole catch at a stipulated price; then from the net returns of sales the dealers deduct the cost of boat and nets, paying the fishermen the balance.

The average catch to the boat during 1879 was 300, making the total catch of the gillers in the upper river 15,000 for the season.

From Johnston's Landing down there is no fishing for market until we reach the vicinity of Savannah, where we find twenty-five nets and boats and fifty men fishing to supply the Savannah market.

The fishing grounds of the Lower Savannah are the straight reaches of the river for some miles above and below the city. The nets are about 100 fathoms long and from forty to fifty meshes deep. They are laid out across the channel, and from the extreme narrowness of the river they occupy and obstruct a considerable portion of the entire breadth. With twenty-five of these nets in the water at once, in *échelon*, and at no great distances apart, a very effectual obstruction to the upward movement of fish is established.

STURGEON FISHERY.—The sturgeon fisheries of the Savannah are of considerable commercial importance. In the lower part of the river, in the vicinity of Savannah, and for some 40 miles above, this fish is pursued by professional fishermen from the Northern States, especially Connecticut, New Jersey, and Delaware, who later in the season carry on the same work in the Delaware. The same nets are earlier in the season kept busy in the Saint Mary's, the Satillas, and the Altamaha. The product of all these fisheries centers at Savannah, and the details are given in full in the section on the subject of the sturgeon trade of that place.

STATISTICS FOR 1880.—The following is a summary of the fisheries of the Savannah River for 1880:

No of men employed in the fisheries		331
Amount of capital employed		$9,395
Product of the fisheries:		
Shad	pounds	138,250
Sturgeon	do	88,500
Mixed fish	do	361,500
Value of products	do	$26,754

* Cast-nets are used in the Savannah River in fishing for shad, trout, red-horse, &c., and all along the southern coast for taking shrimp, mullets, &c. They are likewise in use in all the lakes and small streams of the interior. Their use is only possible in comparatively shallow waters with a clear bottom, for if there be rocks or snags the net will hang and the fish escape. The cast-net is used to great advantage in the mouths of the rice trunks. When the tide runs down, trout, silversides, and suckers collect in the pools, and are sometimes taken a half bushel at a throw.

7. THE STURGEON TRADE OF SAVANNAH.

From the different inlets of the Georgia coast and from the Satilla River, the Altamaha, the Ogeechee, the Savannah, and the Cohambee rivers a considerable number of sturgeon find their way to the Savannah market. Here they are dressed, packed in ice, and shipped by steamer to New York. The roe, also, after some preliminary process here, is shipped to New York to be converted into caviare.

The sturgeon are taken in drift-nets of 12-inch mesh, No. 40 cotton twine. The length of net varies from 80 to 150 fathoms, and is from 18 to 26 meshes deep. The length and depth vary with the width and depth of the river in which they are to be used. Two men and boats are necessary for each net. The cost of a fishing outfit is on an average $130. Where the fishing is done by hired crews the men receive from $25 to $40 per month. Where the fishing is on shares the party furnishing outfit receives one-third of the proceeds, and the outfit is returned, but the nets are not serviceable more than one season.

The fishing begins first on the Satilla. In 1880 the camps were established on the 6th of February, but the season did not fairly open until the 18th.

The sturgeon as taken are either penned or tied out in the water and kept alive until a shipment is made up, when they are killed, disemboweled, heads and tails cut off, and shipped to Savannah. Here they are skinned, the backbones taken out, packed in ice, and forwarded to New York, and sold at a price of 6 or 8 cents per pound.

The species of sturgeon which is the object of this fishery is the *Acipenser oxyrhynchus*, or sharp-nose sturgeon.

The average weight, gross, of the sturgeons brought to Savannah is about 150 pounds. The average weight, net, is 65 pounds. The largest size seen by Mr. Hudson, one of the principal dealers here, weighed 250 pounds.

The fishing equipments in use during the season of 1880 were as follows:

Locality.	Nets.	Men.
On the Satilla River	4	10
On the Altamaha River	30	66
On the Ogeechee River	10	22
On the Savannah River	2	5
On the Combahee River	2	5
Total	48	109

These nets are not confined to one river or locality; these now being fished in the Satilla, later in the season will be transferred to the Savannah or rivers farther east and north.

According to the best estimates which I can make, the average catch per net [redacted] one hundred, which gives 15,000 pounds gross and 6,500 pounds net weight to each [redacted]

Of the roe, we have an average of fifteen sturgeon to the keg of 125 pounds, wh[redacted] kegs of roe to each fishing outfit. I have not learned that there is any use made [redacted] could, of course, be used in the preparation of oil.

We have the following statistical summary of the product and value of the sturgeon trade of Savannah and of the men and capital engaged in it:

Number of fishing equipments engaged	48
Value of same	$6,240
Number of men employed	109
Average number of sturgeon to net	100

Total number taken	4,800
Gross weight of sturgeon to net ..... pounds..	15,000
Net weight of sturgeon to net ..... pounds..	6,500
Weight of roe to net ..... pounds..	875
Number of pounds of dressed sturgeon marketed	312,000
Value of same, at 7 cents per pound	$21 840
Number of pounds of roe (336 kegs, each 125 pounds)	42 000
Total value of roe	$2 940
Total value of the sturgeon trade of Savannah	$24,780

S. FISHERIES OF THE EDISTO RIVER, SOUTH CAROLINA.

The Edisto River lies wholly within the limits of South Carolina, having its sources chiefly in the sandy belt. Its waters, being filtered through extensive tracts of swamp and low ground, are usually clear, even in seasons of high water, but always with a transparent brown tint from the infusion of vegetable matter. The tide ebbs and flows as high as the crossing of the railroad about 40 miles above its mouth. There are no obstructions, natural or artificial, in this river or in either of the main tributaries. At Orangeburg there are several "hack" and "fall" traps, which take some shad every season for local supply, but these do not invade the river channel. Rafting of timber is carried on extensively on the Edisto and its tributaries, and the active prosecution of this industry upon this and other Southern rivers has exerted a conservative influence upon the fisheries by maintaining an open channel for the passage of fish. The shad fishery—the first in importance—has fallen off very much of late years, for reasons not clearly understood. The second and only remaining fishery of importance is that for the capture of sturgeon, which is prosecuted in the mouth of the river, where the depth of the water and the width of the channel permit "drifting," *i. e.*, "floating of the net." On March 6, 1880, we found quantities of sturgeon moving up the river 40 miles above the mouth. Indeed, they almost caused a close season for the shad fishermen by running in their nets and tearing them to pieces.

Fishing for shad is prosecuted almost entirely with gill-nets. There are no fykes or pounds and only a single haul-seine, which is dragged 9 miles below the railroad crossing. This seine is worked by a crew of six negro men in the most improvident and careless way and to very little profit.

The gill-nets have a 5-inch mesh and are made of No. 40 twine. They reach to the bottom of the river and are stretched from bank to bank. Whilst in the river they form as effective an obstruction to the passage of the grown fish as if they were so many impassable dams. Fortunately for the fish, the waters of the Edisto are so clear that the nets are not set during the day, because the fish will not enter them. The nets are put out when the flood tide is three-fourths run, and stand until the ebb tide begins to run strong, when they must be taken up, lest the strength of the current should break the anchoring ropes. Consequently there is but one "laying out" or setting of the net in twenty-four hours, unless the ebb tide makes about sundown, when there is ebb again [illegible] sunrise.

[illegible] height and length of the net is made to correspond with the breadth and depth of the [illegible] On each bank is a round pole, to which the end of the net is fastened. These poles are [illegible]ed with lead or other heavy material in order to keep them upright. To each pole is attached a "rope bridle." The ropes are brought together and the ends securely fastened to stakes or trunks of trees on the shore. In no case are the nets set at a less distance than 300 yards apart. A State law prohibits their being placed nearer.

There was but a single camp for sturgeon fishing on the Edisto during the season of 1880. The fish taken here are shipped to Charleston by schooner, where they are packed in ice and sent to New York by steamer. The nets do not differ in any respect from those employed all along the Atlantic coast in the same fishery. The number of fish taken to the net was 125.

The statistics of the fisheries of the Edisto for 1880 are given in the following summary:

Number of men employed		156
Amount of capital employed		$3,610
Product of the fisheries:		
Shad	pounds	90,000
Sturgeon	do	37,250
Mixed fish	do	125,000
Value of the product		$12,285

9. THE SANTEE RIVER.

The Santee River has no organized fisheries for shad or alewives. While undoubtedly a considerable number of fish must be taken in so large a river, with its numerous tributaries draining so extensive and diversified a section of country, yet the information that was obtained was so indefinite as not to warrant the expenditure of the time which would have been necessarily consumed in arriving at an approximation of the products of this river.

Shad in considerable numbers were formerly taken at Columbia, situated at the junction of the Saluda and the Broad. Indeed, in the early history of the country important shad fisheries existed on the main tributaries of the rivers as far up as 150 or 200 miles above Columbia. At the present time only stragglers occasionally ascend the river as high as the dam, just above Columbia. It is probable that productive fisheries, both for shad and sturgeon, could be established at the mouth of the Santee River were it not for the fact that the markets are so inaccessible as to have deterred private enterprise from attempting to develop them.

10. THE PEDEE, SAMPIT, BLACK, AND WACCAMA RIVERS.

All these rivers are tributaries of Winyah Bay, and their product of fish is included under the statistics of Winyah Bay and its tributaries. The only fisheries prosecuted are for shad, chiefly in the Waccama River, and for sturgeon in that river and in Winyah Bay. The product of these fisheries is concentrated at Georgetown, because the tri-weekly steamer from that point to Charleston furnishes the only means of transportation to market.

Fishing for shad gives employment to about sixty men, including those engaged in supplying the local demand for fish, the catch of which is only estimated, as no definite information in regard to the quantities taken could be gained.

The sturgeon fisheries of Winyah Bay are extensive and valuable, and are prosecuted chiefly by professional fishermen from the Delaware, who, later in the season, pursue the same avocation on that river. On March 11, 1880, when these fisheries were visited by the agent of the U. S. Fish Commission, two parties or camps were engaged in the sturgeon fishery on this bay.

The fishing outfit for each "camp" consisted of huts for the men, a long scow with a cabin at each end, one of them being used as quarters by a portion of the men; the other, devoted to the preparation of the caviare for market. The middle portion is [illegible] over and used as a platform for slaughtering and dressing the sturgeon for market. A [illegible] ed for carrying away the offal, and a 15-ton schooner transported the dressed fish [illegible] to Georgetown. There

it was packed in ice and shipped by steamer to Charleston, thence to New York. The boats employed for "gilling" were the ordinary Whitehall boats. Two men fish a net. These average about one hundred fathoms in length. The sturgeon which are taken at each drift are transferred to floating pens made with slatted sides and bottom, so as to permit a free circulation of water. The pens, or live-boxes, containing the male sturgeon, or "bucks," are kept tied close up to the scow. It is, however, necessary to anchor the pens containing the female or "roe," sturgeon out in the bay, remote from shore; otherwise the eels, which are abundant in the creeks and along shore, would enter their vents and eat out the roes, and thus destroy the most valuable part of the fish, which is prepared as caviare for market.

Twice a week the fish that have been taken in the interval are slaughtered on the scow, the heads and tails being first cut off. While the fish are still alive their belly is ripped open and the roe taken out, placed in buckets, and handed over to the expert who is charged with the preparation of the caviare. The fish are then skinned and split down the backbone, divided longitudinally into two halves, and stacked up until the slaughtering is completed, when they are transported to the schooner and shipped to Georgetown.

A great deal of mystery enshrouds the preparation of the caviare. In fact, however, it seems to consist simply in passing the roe through sieves, in order to separate the fibrous matter which adheres to it, and then salting it down in barrels capable of holding 100 pounds each. The quantity and kind of salt used could not be ascertained.

Statistical summary of the fisheries of Winyah Bay and its tributaries for 1880.

Number of men employed		97
Amount of capital employed		$4,050
Product of the fisheries:		
Shad	pounds	78,400
Sturgeon	do	224,000
Mixed fish	do	300,000
Value of the products		$23,028

2.—THE RIVERS AND SOUNDS OF NORTH CAROLINA.

By Marshall McDonald.

1. CAPE FEAR RIVER.

The basin of this river and its tributaries lies wholly within the State of North Carolina. It is navigable for steamers up to Fayetteville, N. C.; a short distance above this point are the first falls of the river. Here a dam has been erected in connection with the slack-water navigation of Deep River, the main tributary of the Cape Fear. This obstruction, of course, prevents the further upward migration of the shad. From Fayetteville to the mouth of the Cape Fear River organized fisheries are prosecuted for the capture of shad. In 1880, when the examination of the river was made, the importance of these fisheries had decreased very much, the product at that time not exceeding 45,500 in number for the whole river. This entire quantity of fish found a local market on the river at good prices, the average being about 30 cents apiece.

Drift-nets, skim-nets, and haul-seines are operated on this river, the different kinds of apparatus for capture being adapted to the locality. In the vicinty of Fayetteville several haul-seines are in use; there is also another at the mouth of the river in the vicinity of New Inlet.

Skim-nets for the supply of fish for local requirements are fished all along the river from Wilmington to Fayetteville. Drift-net fishing is confined to a stretch of about 40 miles of river extending above and below Wilmington.

The season for shad fishing extends from January 20 to May 1. Ripe fish are found in the river about March 1.

Herrings (*Clupea*) are taken in limited numbers in the vicinity of Wilmington in drift-nets. The run of this fish into the Cape Fear River and all rivers south of it is very insignificant compared with the vast schools which annually pass into the Albemarle and its tributaries. The most important fisheries of the Cape Fear are those for the capture of sturgeon. The methods and apparatus used do not differ from those which have been already described as in use on the more southern rivers of the Atlantic coast. The nets and boats are furnished by dealers at Wilmington, who in some cases receive a stated portion of the catch, and in others a rental for the use of the nets, &c., the dealers buying and receiving all the sturgeon at prices mutually agreed upon. If a dealer owns the boats and nets, the catch is divided equally between himself and each of the two men.

This fishery gives employment to 20 nets and boats, which are usually skiffs, and 40 men. The value of a fishing outfit, including net and boat, averages about $40.

The sturgeon fishing season for the New York market lasts from March 10 to the end of April and from September 10 to November 1. To some extent, however, this fishery is prosecuted all the summer in order to meet local demands and supply the interior towns of the State. The average catch of a net for the fall fishing is about 200 fish and for the summer fishery about 50, making a total average of 250 per boat for the entire season.

The fish intended for shipment to New York are dressed and packed in ice. Those for State consumption are shipped whole. No use is made of the roe.

The product of these sturgeon fisheries is concentrated chiefly in the hands of two dealers, Messrs. John Carroll and William Davis. The average weight of a dressed sturgeon, according to Mr. Carroll, is 60 pounds. Ripe and spent sturgeon are taken both in the spring and fall fisheries.

The following are the statistics of the Cape Fear River for the season of 1880:

Number of men employed		270
Amount of capital employed		$6,238
Product:		
Shad	pounds	182,000
Sturgeon	do	262,000
Mixed fish	do	537,000
Value of product		$40,210

In addition to the above-named species, about 1,200 pounds of rock and 25,000 pounds of red-horse and other varieties are annually taken as an incidental product of the shad fisheries. Catfish are found in large numbers in the river, and at one time, as an experiment, a number were shipped to market, but objection was made to the color of the meat, and the enterprise therefore proved to be unprofitable and was abandoned.

2. FISHERIES OF THE NEUSE RIVER.

DESCRIPTON OF THE RIVER—IMPORTANCE OF THE FISHERIES.

While the headwaters of this river are in a clay section of the State, viz, Orange, Granville, and Pearson Counties, the principal area of its basin lies in the Sandy and Poquosin belts, and consequently the water at ordinary stages is clear and dark colored. Continued rains about the sources

bring down floods which frequently prevent the seine-haulers from fishing for several days at a time. The same result is produced at ordinary stages of water by easterly winds, which retard the current and produce the effect of heavy rains. As is elsewhere stated, the skim-netters carry on their operations when seine hauling is impossible for reasons above given. The fish during these times of swollen waters pursue their upward migrations comparatively unobstructed and unmolested; indeed, it is doubtful whether but for such opportunities there would at the present time be any fisheries in the Neuse River worthy of mention.

The product of the fisheries on the Neuse River bears a favorable comparison with that of other streams in the South Atlantic States; but of late years the supply has materially decreased in all the rivers owing to overfishing and the erection of obstructions. In former years the shad ascended the Neuse in great numbers into Western North Carolina, and profitable shad fisheries were operated as high as Raleigh. At the present time shad fishing for market does not extend farther up the river than Kinston, which is at the head of steamboat navigation on the Neuse; several thousand shad are, however, annually taken above that point in skim-nets, fish-slides, and hack-traps, but are used for local trade only. All the shad taken by the pound-nets, stake-nets, and seines are sent to New Berne, whence they are shipped by steamer and rail to Northern cities during the early part of the season. The principal firms in New Berne thus engaged are those of C. T. Watson, B. B. Lane, T. Daniels, G. N. Ivis, D. Bell & Co., C. L. Dickinson, F. M. Augostine, and A. W. Nelson. As the season advances, however, and the cities in the North receive fish from more northerly points on the Atlantic, the price of Southern fish becomes depreciated, and it is no longer profitable for the New Berne and other shippers to send their fish North. Thenceforward to the close of the season the majority of the fish taken are shipped to the interior of the South Atlantic States.

In former times the fishing below Kinston was mainly prosecuted with haul-seines, skim-nets being used in the upper part of the river, *i. e.*, above Kinston. In later years stake-nets have begun to take the place of haul-seines, and the fishermen have ascertained that stake-nets planted in the lower regions of the river below New Berne cut off the run of the fish in the river to such an extent as to render haul-seining no longer profitable. Within the last few years, however, pound-nets have been introduced into the river below New Berne, and it is more than probable that before the lapse of many years they will be substituted for the stake-nets. Judging, however, by the tone of the present legislature of North Carolina, and in view of the fact that the majority of the fishermen can better advance their interests by employing other modes of fishing than by the use of pound-nets, it is quite probable that the employment of these nets will be largely restricted, if not actually prohibited by legislation.

APPARATUS.

Seven kinds of nets are used on the Neuse for the capture of fish, chiefly shad; of these the haul-seines, skim-nets, and gill-nets are mainly employed between New Berne and Kinston, and the stake, drag, and pound nets between New Berne and the mouth of the river.

STAKE, OR SET NETS.—There are 3,750 of these nets used below New Berne, handled by 150 men, each of whom tends 25 nets. Above New Berne 160 set-nets are fished by 16 men. The majority of the set-nets are owned and worked by fishermen from Carteret and other coast counties. These men, except during the shad season, are engaged in salt-water fisheries. Probably 1,200 set-nets are owned by the fish dealers of New Berne. The set-net averages 20 yards in length, the depth differing with the depth of water. The size of the mesh is from 5¼ inches to 6 inches. The nets are stretched by staffs or poles at each end, and are set down-stream. Were

these nets set at right angles with the current, its force would tear them to pieces, and passing vessels would run them down. Above Kinston the nets are smaller and are used by the farmers chiefly to supply their own tables. The set-net fishing in the season of 1879–'80 was very unprofitable, owing to the continuous state of low water in the river, and its consequent clearness and brackishness.

The following summary shows in detail the facts concerning the set-net fishing on the Neuse, for the season of 1879–'80:

	Number of men.	Number of set-nets.	Value.	Number of boats.	Value.
From New Berne to mouth of river	150	3,750	$7,500	75 at $10	$3,000
From New Berne to Kinston	16	160	480	8 at 10	80
Total	166	9,910	7,980	83	3,080

DRAG-NETS.—*About 25 of these nets are fished below, and are owned in New Berne.* The crew consists of three men, the captain, who receives one and a half shares, and two men who receive a share each, the remaining one and a half shares (making five shares in all) being the property of the net and boat. These drag fishermen have no settled fishing grounds, making their hauls at a venture, and rarely twice in the same place. Being prohibited by law from landing their seines on the beaches or shores, they are compelled to work in the water waist deep. To one end of the net is fastened a pole which at the moment of making the haul, is thrust into the bottom; the free end is then drawn toward and past the pole end (the lead-line being kept down with the foot) until the fish are hunted in the end of the seine next to the staff, which is then drawn up. The seine is now "footed up" and the fish are emptied into the boat.

The following table shows the number of men, boats, and nets engaged in the drag-net fishing, and the amount of capital employed. The boats and nets are usually furnished by New Berne dealers:

Number of men	75
Number of nets	25
Value of nets	$1,250
Number of boats	25
Value of boats	$1,250
Total amount of capital employed	$2,500

THE POUND, DUTCH, POT, OR TRAP NET.—This net has only come into use, as above stated, of late years. Four are fished in the Neuse River below New Berne, one at the mouth of Trent River, and one in Upper Broad Creek; all are owned by New Berne fish-dealers.

Below is a summary of the men, nets, and boats engaged in this fishery:

Number of men employed	12
Number of nets	6
Value of nets	$1,500
Number of boats	6
Value of boats	$240

HAUL-SEINES.—Below New Berne are four beaches where the haul-seine is used. These seines average from 500 to 800 yards in length, and require crews of 10 men each, one seine being hauled by horse-power. Between New Berne and Pitch Kettle 23 haul-seines are in operation, and between Pitch Kettle and Kinston are 6 or 8 small seines, which supply local markets, rarely shipping to any great distance.

Below is a statistical summary showing the number and value of the haul-seines and boats tending the same in operation on this river, and the number of men employed:

Designation of fishery.	Number and description of seines.	Value.	Number of men.	Boats, number and description.	Value.
Four seines below New Berne, crews of 10 men	From 500 to 800 yards	$1,000	40	4 flats	$160
Lewis Fishery	1 seine, 125 yards	75	4	1 canoe	75
Wood's Beach	do	75	4	do	75
Canady's Beach	1 seine, 100 yards	75	4	do	75
Lewis's Beach	do	50	4	do	50
Nelson's Beach	*2 seines, 120 yards*	75	6	2 canoes	100
Gatlin's Beach	2 seines, 100 yards	100	6	2 flats	75
Parish's Beach	do	100	6	do	50
G. Nelson's Beach	2 seines, 150 yards	120	6	do	55
Watson & Lane	1 seine, 150 yards	100	5	1 canoe	70
Ives's Fishery	1 seine, 120 yards	90	5	do	70
Spring Garden	1 seine, 150 yards	100	8	do	60
Watson's Beach	do	80	8	1 flat	60
Dolly Gut Fishery	do	100	8	do	60
Ewell's Lower Beach	1 seine, 80 yards	80	4	do	30
Ewell's Upper Beach	1 seine, 100 yards	90	4	do	35
Cohart's Beach	1 seine, 80 yards	75	4	do	25
Jackson's Beach	do	75	4	do	25
Caraway & Wiggins	1 seine, 150 yards	75	4	do	25
Watson's Beach	*1 seine, 80 yards*	65	4	do	25
Anderson's Beach	do	65	4	do	35
Mud Seine Beach	1 seine, 90 yards	70	4	do	30
Kitchen Landing	*1 seine, 100 yards*	75	4	do	25
Pitch Kettle	1 seine, 125 yards	75	4	do	25
From Pitch Kettle to Kinston, 10 small seines	10 seine, 60 yards	240	30	10 flats	100
Total	41 seines	3,135	186	41	1,415

SKIM OR BOW NETS.—On the Neuse, and many other southern rivers, "skimming" is a common and very effective mode of fishing, especially in the upper reaches of the river where on account of the contraction of the banks the fish are compelled to ascend in almost single file. The frame of the skim-net is a bow of tough, light wood, bent and secured.

The shape of the bow is a long oval, the longest diameter of which is 10 to 12 feet. The mesh is of hemp twine, about No. 60. The cost of the net complete is from $2 to $2.25, and the canoe costs about $5, making a fishing outfit complete, $7.

Two men are required to fish each net; one sits in the stern of the boat and guides its motion; the other stands in the bow holding the net in a vertical position, the shoulder-block resting on the thwarts of the boat. A trip-string, attached to the bag of the net and held in the hand, signals to the bow-man the slightest touch of any foreign object in the net. A dexterous twisting motion secures the fish (if it be a fish) and delivers it in reach of the free hand. At dusk the boat, equipped for fishing, paddles out into the current and drifts noiselessly with the bow down-stream. The man in the stern uses the paddles only to guide the boat. When several boats fish in the same reach they follow each other in single file. Sometimes as many as five or six may be seen in a line.

Skim-nets are used to the best advantage when the river is running high, at which stage the seiners are driven from their beaches, and the fish, by reason of the turbid waters, are easily netted. During the season 1878–'79 one boat and skim-net at Cowpens took eight hundred shad, and catches of three hundred and four hundred to the net for a season were by no means uncommon. In the estimates, however, one hundred has been used as the average catch for each net. Skim-

nets are in use all along the river from 9 miles above New Berne to the vicinity of Raleigh. Above Kinston this operation is carried on for the most part by farm hands in the early morning and in the evening.

Below is a tabular statement showing the number of men, with boats, nets, and their value, engaged in skimming, and the amount of fish taken. Between Kinston and Raleigh the average catch is estimated at only fifty shad per net during the season :

Location.	Number of men.	Number of boats.	Number of nets.	Value of boats and nets.	Average catch.	Total catch.
From 9 miles above New Berne to Cowpens	40	20	20	$140	100	2, 000
At Cowpens	32	16	16	112	100	1, 600
From Cowpens to Pitch Kettle	30	15	15	105	100	1, 500
At Pitch Kettle	20	10	10	70	100	1, 000
Pitch Kettle to Kinston	50	25	25	175	100	2, 500
Kinston to Raleigh	100	50	50	350	50	2, 500
	272	136	136	952	.....	11, 100

GILL-NETS.—The use of these nets on the Neuse River is prohibited by law, but six or eight are nevertheless fished during the night between New Berne and Pitch Kettle.

PROPORTIONS OF BUCK AND ROE SHAD.

The following table will show the proportion existing between the number of buck and roe shad taken in several seines on the Neuse River during the season of 1879:

1879.	Season.		Catch of shad.		Total.	Per cent. of bucks.	Per cent. of roes.
	Began.	Ended.	Buck.	Roe.			
Dollygut (1 mile below Cowpens)	Mar. 10	Apr. 15	1, 153	945	2, 098	54	46
Ewell's Upper Beach (Cowpens)	Mar. 8	May 18	1, 398	995	2, 393	58	42
Ewell's Lower Beach (Cowpens)	Mar. 8	May 4	1, 399	960	2, 359	59	41
Total	.....	.....	3, 950	2, 900	6, 840	.....	.....

During the same season also the firm of C. T. Watson handled as follows:

Month.	Buck shad.	Roe shad.	Per cent. of bucks.	Per cent. of roes.
February	543	271	.....	.....
March	3, 219	3, 098	.....	.....
April	2, 404	1, 135	.....	.....
May	548	590	.....	.....
Total	6, 714	5, 049	57	43

An analysis of the above tables shows, first, that the number of male shad is considerably in excess of the number of female shad for the season; second that the preponderance of males over females is very great at two periods during the season. This inequality in the run of males and females, and the capture of so large a proportion of males in advance of the maturation of the females, would indicate that the loss of fruitful eggs in the spawning season from lack of fecundation must be enormous.

SHAD "RUNS."—The great preponderance of buck shad at the beginning of the season, and again in April, would indicate that in the Neuse River, at east, there are two distinct runs of shad, viz, in January and in May. This conclusion agrees with the general belief of the fishermen on all the rivers of Carolina. Although the first run commences in January, shad fishing does not begin until the month following. The average duration of the entire fishing season is sixty days.

STATISTICAL REVIEW OF NEUSE RIVER FISHERIES.

The following tables show the number of men, with nets and boats, and value of the same, employed in the Neuse River fisheries during the season of 1879–'80, also the quantity and value of the products and disposition of the same:

Description of fishery.	Number of men employed.	Nets.		Boats.		Total capital invested.
		Number.	Value.	Number.	Value.	
Stake-net	166	3,010	$7,980	83	$3,080	$11,060
Drag-net	75	25	1,250	25	1,250	2,500
Haul-seine	186	41	3,135	41	1,415	4,550
Pound-net	12	6	1,500	6	240	1,740
Skim-net	272	136	476	136	476	952
Total	711	4,118	14,341	291	6,461	20,802

Disposition.	Shad.		Herring.*		Mixed fish		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Shipped to interior markets	49,698	$12,424	442,000	$2,652	2,106,692	$17,557	2,598,390	$32,633
Shipped to Northern cities	15,624	4,687			149,230	1,641	64,854	6,328
Estimated for consumption in New Berne	5,000	1,250	100,000	600	300,000	2,500	405,000	4,350
Estimated for consumption along the river	8,000	2,000	100,000	600	300,000	2,500	408,000	5,100
Total	78,322	20,361	642,000	3,852	2,756,112	24,198	3,476,434	48,411

*Clupea æstivalis and C. vernalis. †Of this number 15,000 are rock and 28,890 bass.

3. FISHERIES OF PAMLICO AND TAR RIVERS.

Pamlico River as designated on the charts is only the estuary of Tar River. The physical and hydrographic features of Pamlico River are in general similar to those of the Neuse below New Berne.

The methods of fishing pursued in Pamlico and Tar Rivers are the same as on the Neuse River with this exception, that near Washington, N. C., a large seine, like those used on the Albemarle River, is operated.

As on the Neuse River, the principal fisheries are those for the capture of shad and herring, the former being by far the more important.

All the fish taken from this river, with the exception of those retained for local consumption, are sent to Washington, N. C., whence, after having been packed in ice, they are transported by rail to a point on the Roanoke River. Here they are placed on board a steamer and shipped to Norfolk, from which point they are distributed, as consigned, to the various Northern cities. The product of the Pamlico River fisheries, as also the number of men employed, is about the same as that estimated for the Neuse River. But in the absence of detailed information on the subject, no statistical summary is given.

4. FISHERIES OF PAMLICO SOUND.

PHYSICAL AND HYDROGRAPHIC FEATURES.—At some distance from and stretching along the coast of North Carolina is a narrow chain of low sand reefs and islands, between which and the mainland lies a broad sheet of water, called Pamlico Sound. Communication between this water and the ocean is possible only through certain narrow openings between the reefs and islands. The three principal passages are known as Oregon, Ocracoke, and Hatteras Inlets. Through these openings is discharged the entire volume of water pouring into the sound from those sections of North Carolina and Virginia which are drained by the Neuse and Tar Rivers, and also those streams, such as the Roanoke and Chowan, which empty directly into Albemarle River or Sound,* and thence into the Pamlico. The result of this continual influx of fresh water into Pamlico Sound is to counteract the effect of the natural ebb and flow of the ocean tide. For this reason there are no tides in Pamlico Sound except such as are produced by heavy winds. During certain seasons of the year, therefore, the water in these sounds is at most brackish, and after the rivers have been swollen by rains sometimes quite fresh.

MOVEMENTS OF THE FISH.—By reference to the statistics of the fisheries of the Neuse and Tar Rivers, and of the tributaries of the Albemarle, it will be seen that immense numbers of shad and herring ascend those streams annually, and it is equally manifest that these fish enter those rivers from Albemarle or Pamlico Sound. A question here arises, and it is of the highest moment to the fisheries that a positive solution be arrived at, as to whether these fish winter in one or both of these sounds or pass into the ocean through the inlets already referred to, returning in the spring for the purpose of making their annual ascent of the rivers. If the former be the case, it is only necessary to find out their winter quarters in order to establish valuable winter fisheries for the shad and herring. If the latter theory be true, then at the time of their passage through these exceedingly narrow inlets, millions of fish might with ease be captured. To this end seine fisheries have repeatedly been established at these passage-ways, but the results, so far at least as shad and herring are concerned, have in no case been such as to make the theory tenable. In the discussion of the relations of the migrations of the fish to water temperatures in general, arguments will be advanced in support of the theory that these fish winter in waters between the reefs and the mainland, be it in Pamlico or in Albemarle Sound.

FISHING GROUNDS.—The only important fisheries for shad and herring conducted on the waters of Pamlico Sound are at its upper end, or, more strictly, in that narrow sheet of water connecting Albemarle and Pamlico Sounds, and named, as already stated, Croatan Sound. At this point large numbers of stake-nets and several haul-seines are in operation. The statistics relative to these fisheries will be given in the summation of the fisheries of the Albemarle and its tributaries.

5. ALBEMARLE SOUND AND ITS TRIBUTARIES.

The magnificent sheet of inland water known as Albemarle Sound stretches east and west from the coast to a distance of about 40 miles into the interior. Through Croatan Sound it discharges all of its waters into the Pamlico Sound. At its head it receives the waters of the Roanoke and the Chowan Rivers, two of the principal streams on the Atlantic slope. The headwaters of the Roanoke drain a considerable portion of Western North Carolina and Southwestern Virginia, the extreme sources of both of its principal tributaries being in the Appalachian range.

* Albemarle Sound is formed by the confluence of the Chowan and Roanoke Rivers, and its waters are discharged into the upper end of Pamlico Sound through Croatan Sound.

The principal tributaries of the Chowan are the Nottoway and the Meherrin. The sources of these rivers do not penetrate to the mountains, and this difference in the physical features of the two river basins entails corresponding variations in the character of the rivers themselves. The muddy waters which pour down the Roanoke during the seasons of high water bear a marked contrast to the dark and clear waters of the Chowan.

A number of minor tributaries of the Albemarle are North, Pasquotank, Little, Perquimans, and Alligator Rivers. These do not penetrate far into the interior, but all of them formerly received each season vast schools of herring and shad. At the present time, however, the fisheries on these rivers have become unproductive in consequence of the diminution of the supply. The main fisheries of the Albemarle are found about the head of the sound and for a short distance up the Roanoke and Chowan Rivers.

The waters of the Albemarle Sound are always fresh; indeed, it is only in dry seasons that the waters of the sound become at all brackish. In the season of 1880, during the whole of which extreme drought prevailed, the water was somewhat brackish as high up as Palens fishery, where several salt-water species were captured in considerable numbers.

The fishing season for the large haul seines on the Albemarle begins between March 1 and 15, although shad are sometimes taken in gill-nets in the Sound some weeks earlier. The following summary of fishing records for Willow Branch Fishery from 1835 to 1874, which was compiled by the late Professor Milner from the books kept at the fishing shore, gives a number of interesting data in regard to these fisheries. The duration of the fishing season and the date of maximum run, both for shad and herring, is found to vary widely from year to year. These fluctuations are due to corresponding changes in the meteorological conditions, which are of course impressed upon the waters.

Summary of fishing records for shad and alewives kept at Willow Branch Fishery, North Carolina, from 1835 to 1874.*

Years and months.	Beginning of season.	Ending of season.	Number of days.	Total of shad.	Total of alewives.	Average per diem of shad.	Average per diem of alewives.	Date of maximum.	
								Shad.	Alewives.
1835	March 15	May 9	51	33,259	484,600	652	9,502	April 6–14.	April 13–19.
March			12	5,441	57,600	453	4,800		
April			30	26,845	344,500	898	11,483		
May			9	1,173	82,500	130	9,166		
1836	March 16	May 7	53	13,231	1,236,700	249	23,333	April 16–19.	April 17–26.
March			16	3,160	28,100	197	1,756		
April			30	9,619	939,600	320	31,320		
May			7	1,462	269,000	208	38,428		
1837	March 16	May 6	52	34,769	1,982,300	657	38,121	April 9–21.	April 23 and 24.
March			16	7,453	76,700	465	4,793		
April			30	24,506	1,635,600	818	54,520		
May			6	2,060	270,000	343	45,000		
1838	March 18	May 8	52	32,204	1,093,100	619	21,021	March 30–April 6.	April 17–19.
March			14	9,480	56,100	677	4,007		
April			30	19,739	795,000	657	26,166		
May			8	2,985	252,000	373	31,500		
1839	March 14	May 9	57	73,130	1,595,000	1,282	27,981	April 4–6.	April 26–May 2.
March			18	27,946	90,500	1,552	5,027		
April			30	43,351	1,205,000	1,445	40,166		
May			9	1,833	300,000	203	33,333		

*Willow Branch Fishery, North Carolina, situated just within the mouth of the Chowan River, was one of the most valuable of the extensive seine fisheries lying around the head of the Albemarle. Its records, running almost continuously from 1835 to 1874, present most interesting material for study; and, when taken in connection with other records of the Albemarle fisheries which are extant, and contemporaneous meteorological observations will probably furnish valuable conclusions in regard to the laws or influences determining the great seasonal fluctuations in the river fisheries.

Summary of fishing records for shad and alewives kept at Willow Branch Fishery, North Carolina, &c.—Continued.

Years and months.	Beginning of season.	Ending of season.	Number of days.	Total of shad.	Total of alewives.	Average per diem of shad.	Average per diem of alewives.	Date of maximum.	
								Shad.	Alewives.
1840	March 12	May 5	55	51,674	3,313,900	939	60,252	March 12–16.	April 16–23.
March			20	26,115	164,900	1,405	8,245		
April			30	22,756	2,985,000	757	99,500		
May			5	823	164,000	164	32,800		
1841	March 11	May 7	58	29,248	2,148,775	504	37,047	March 22–27.	April 16 and 23.
March			21	12,806	102,775	609	4,894		
April			30	16,014	1,665,000	533	55,500		
May			7	428	281,000	61	40,142		
1842	March 6	May 2	58	55,784	1,367,075	961	23,570	March 8–13.	April 21–24.
March			26	44,353	244,500	1,705	9,403		
April			30	11,373	1,105,575	379	36,852		
May			2	58	17,000	29	8,500		
1843	March 15	May 8	55	31,615	1,680,100	574	30,547	April 6–12.	April 21–28.
March			17	3,941	83,000	231	4,882		
April			30	25,894	1,293,100	863	43,103		
May			8	1,780	304,000	221	3,800		
1844	March 16	May 1	47	60,205	1,402,600	1,280	29,842	March 22–28.	April 16–22.
March			16	21,701	84,100	1,356	5,256		
April			30	38,414	1,314,500	1,280	43,816		
May			1	90	4,000	90	4,000		
1845	March 13	May 2	51	53,179	1,556,000	1,042	30,509	March 31–April 3.	April 16–20.
March			19	31,832		1,675			
April			30	21,287	1,537,000	709	50,900		
May			2	60	29,000	30	14,500		
1846	March 15	May 1	48	33,117	718,650	689	14,971	April 3–6.	April 18–23.
March			17	10,931	65,350	643	3,843		
April			30	22,112	642,300	737	21,410		
May			1	74	11,000	74	11,000		
1847	March 15	April 29	45	21,157	567,140	470	12,603	March 15–19.	April 13–18.
March			16	11,722	100,000	732	6,250		
April			29	9,435	467,140	325	16,109		
1848	March 14	May 5	53	16,912	638,400	319	12,988	March 31, April 10.	April 28–May 24
March			18	6,821	40,200	378	2,233		
April			30	9,732	540,700	324	18,023		
May			5	359	107,500	71	21,500		
1849	March 19	May 10	53	47,017	389,816	887	7,355	March 24–April 3.	April 10–13.
March			13	16,999	25,676	1,307	1,975		
April			30	27,993	314,180	931	10,472		
May			10	2,085	49,960	208	4,998		
1850	March 12	May 7	57	25,882	451,103	454	7,944	March 15–21.	April 27–May 8.
March			20	14,417	15,486	720	771		
April			30	11,045	275,967	368	9,198		
May			7	420	159,700	60	22,814		
1851	March 11	May 2	53	12,963	428,650	244	8,087	March 12.	April 28.
March			21	7,664	18,990	364	904		
April			30	5,196	390,160	173	13,005		
May			2	103	19,500	51	9,750		
1852	March 8	May 14	68	34,896	744,428	513	10,947	March 21–29.	April 6–24.
March			24	17,877	59,728	744	2,488		
April			30	13,820	454,200	460	15,140		
May			14	3,199	230,500	228	16,460		
1853	March 7	May 8	61	37,880	559,809	620	9,177	March 25–31.	April 25–27.
March			25	20,416	53,300	816	2,132		
April			30	16,273	434,500	542	14,483		
May			6	1,191	72,000	198	12,000		
1854	March 9	May 10	63	28,087	965,500	445	15,325	April 4–6.	April 22–May 2.
March			23	10,996	34,500	478	1,500		
April			30	13,370	664,000	445	22,133		
May			10	3,721	267,000	372	26,700		
1855	March 12	May 11	61	32,112	1,105,100	526	18,116	March 28–April 20.	April 23–May 3.
March			20	10,132	47,200	506	2,360		
April			30	18,300	592,900	610	19,763		
May			11	3,680	465,000	334	42,272		

Summary of fishing records for shad and alewives kept at Willow Branch Fishery, North Carolina, &c.—Continued.

Years and months.	Beginning of season.	Ending of season.	Number of days.	Total of shad.	Total of alewives.	Average per diem of shad.	Average per diem of alewives.	Date of maximum.	
								Shad.	Alewives.
1856	March 17	May 9	54	23, 524	419, 700	417	7, 772	April 10–16.	April 21–28.
March			15	4, 361	23, 200	292	1, 546		
April			30	16, 669	303, 500	555	10, 116		
May			9	1, 474	93, 000	163	10, 333		
1857	March 12	May 15	65	28, 953	569, 200	437	8, 756	March 25–April 9.	April 28–May 2.
March			20	8, 123	28, 400	406	1, 420		
April			30	17, 007	338, 800	566	11, 293		
May			15	2, 923	202, 000	194	13, 466		
1858	March 15	May 12	59	16, 242	245, 280	275	4, 157	April 3–10.	April 15–24.
March			17	5, 744	12, 950	337	761		
April			30	9, 238	206, 200	307	6, 873		
May			12	1, 260	26, 130	105	2, 177		
1859	March 14	April 30	48	12, 002	120, 700	250	2, 514	March 14–17.	April 11–27.
March			18	7, 692	30, 000	427	666		
April			30	4, 310	96, 700	143	3, 223		
1860	March 12	May 12	63	17, 125	144, 100	271	2, 287	March 22.	April 25–27.
March			21	8, 899	20, 700	419	985		
April			30	6, 586	83, 400	219	2, 446		
May			12	1, 730	40, 000	144	3, 333		
1861	March 11	May 14	67	21, 101	915, 450	314	13, 663	April 2–6.	April 22–May 3.
March			21	7, 782	85, 200	370	4, 057		
April			30	17, 468	549, 500	382	14, 983		
May			16	1, 851	280, 750	115	17, 549		
1862	April 7	May 12	36	38, 286	567, 583	1, 063	15, 766	April 7–11.	May 5–7.
April			24	34, 534	301, 135	1, 438	12, 547		
May			12	3, 752	266, 448	312	22, 204		
1863	No record kept.	No record kept.							
1864	No record kept.	No record kept.							
1865	No record kept.	No record kept.							
1866	March 12	May 5	55	36, 599	1, 589, 000	665	28, 890	April 10–12.	April 20–28.
March			20	14, 315	217, 500	715	10, 875		
April			30	21, 605	1, 019, 500	720	33, 983		
May			5	679	352, 000	113	58, 666		
1867	No record kept.	No record kept.							
1868	March 16	May 15	61	31, 551	1, 144, 700	517	18, 765	April 18–28.	April 23–May 5.
March			16	5, 095	34, 700	318	2, 168		
April			30	21, 774	674, 000	725	22, 466		
May			15	4, 682	436, 000	312	29, 066		
1869	March 15	May 15	62	17, 647	583, 950	284	9, 418	April 5–9.	April 21–27.
March			17	4, 041	33, 950	237	1, 997		
April			30	11, 612	426, 000	387	14, 220		
May			15	1, 994	123, 400	132	8, 226		
1870	March 14	May 12	60	15, 099	620, 530	250	10, 342	April 7–14.	April 14.
March			18	3, 657	11, 530	203	640		
April			30	9, 739	421, 000	324	14, 033		
May			12	1, 613	188, 000	134	15, 666		
1871	No record kept.	No record kept.							
1872	No record kept.	No record kept.							
1873	March 17	May 10	65	50, 195	1, 650, 330	912	30, 005	April 7–25.	April 28–May 3.
March			15	2, 797	39, 670	186	2, 440		
April			30	41, 501	976, 360	1, 383	32, 545		
May			10	5, 897	643, 300	589	64, 330		
1874	March 10	May 11	63	30, 893	923, 372	490	14, 656	April 1–6.	April 22–May 5.
March			22	12, 936	24, 672	549	1, 120		
April			30	17, 049	572, 300	568	19, 076		
May			11	1, 758	326, 400	159	29, 672		

APPARATUS AND METHODS OF CAPTURE.

Until a comparatively recent period haul-seines have been the principal means of capture employed in the prosecution of the Albemarle fisheries. These were at first confined to the rivers, but gradually fishing shores were established on the sound. The effect of this has been to diminish the catch of the river seines to such an extent as to render them unprofitable, unless operated with small seines and crews involving correspondingly decreased expenditure of capital.

By degrees stake-nets have been introduced and operated by men of small means; these, however, are principally confined to the lower parts of the sound and to its minor tributaries. About 1870 pot-nets or Dutch-nets, as they are termed, were introduced. These have steadily increased in number each year, much to the detriment of the seine fisheries, since, as in the case of stake-nets, but little capital is needed for their operation.

At the time when the investigation of these fisheries was made these nets exceeded one hundred in number, and a considerable proportion of the catch of shad was taken in them and the stake-nets.

One of the most striking features connected with the Albemarle fisheries is the vast size of the seines operated. The largest of these has a length of 2,600 yards, and each sweep of the seine garners the crop from 1,200 acres. The hauling of the seine is usually effected by steam engines placed on the shore, these having been substituted for horse-power. In 1879 steamboats were first used for laying out the seine and are now in quite general use. In this operation two boats are used; one carries the shore end, the other the sea end of the seine. The center of the fishing-berth is marked by a stake with a bush tied to it, in order that it may be easily seen from the shore. In laying out the seine the boats pull together for the center stake, whence they separate, rowing in opposite directions and paying out the seine. The introduction of steam for this purpose has added greatly to the promptness and facility of this operation, and has rendered comparatively easy its accomplishment in all kinds of weather. The row-boat which carries the shore end is towed to the center stake by the steamer.

The magnitude of the work connected with the operation of one of these large seines is best shown by the following statistics:* The length of the seine is 2,600 yards, the depth 12 yards; size of mesh in breast of seine $\frac{7}{8}$ inch, in the wings $1\frac{1}{2}$ inches. The value of the seine is $5,220; of shore buildings, $2,500; of boats, $1,200; of engines, $1,800; of horses, $1,500. Total expenses for this one seine during the season, $8,500. The number of tons of ice consumed in packing 300, and of the bushels of salt used in the preparation of fish for market 2,000. The number of men employed is 61, of women 15. In 1879 this fishery took 52,700 shad, 900,000 herring, 13,000 pounds of rock, and 12,000 pounds of white perch.

During the season of 1880 there were in operation at the head of the sound, and immediately within the mouths of the Roanoke and Chowan Rivers, eleven large seines. In addition, a number of smaller seines were operated, the seine fisheries on the Chowan extending a short distance above the junction of the Notaway and the Meherrin.

DISPOSITION OF THE CATCH.

The fisheries of the Albemarle Sound reached their present importance through the extension of railroad and water routes south from Norfolk, whereby an easy and rapid communication with Northern markets was effected. The entire catch of shad, rock, and perch is shipped to

*The fishing shore here referred to is that known as "Sutton Beach," at the head of the Albemarle, owned and operated by Dr. Capehart, of Avoca.

market in a fresh condition, the greater portion being packed with ice in boxes, each containing about 225 pounds of fish. From Edenton and other landings the fish are transported by steamboat up the Chowan and Blackwater Rivers to the intersection of the Seaboard and Roanoke Railroad, or by the Dismal Swamp Canal, or yet again by the Chesapeake and Albemarle Canal to Norfolk. The fish are usually consigned directly from the shore to their point of destination. Agents are employed by the owners of the shores to attend to the packing and handling of the fish at Norfolk. Early in the season considerable numbers of herring also are shipped fresh, mainly to Philadelphia and Baltimore. The great bulk, however, is either sold fresh on the shore to the farmers, who carry them to the interior in carts and wagons, or is salted down in barrels and shipped, usually in sailing vessels, to Norfolk. The salt fish are prepared for market in three ways, being known, respectively, as "gross herring," the entire fish being salted down, as "split herring," the head and entrails being removed before salting, or as "roe herring," the head alone being removed, the main gut drawn, and the roe left in the fish. The manipulations connected with this preparation do not differ from those in common use all along the coast.

STATISTICS OF THE FISHERIES OF ALBEMARLE SOUND.

The following statistics show the extent and value of the fisheries of Albemarle Sound and its tributaries for the season of 1880:

	Number.	Value.
Men employed*	1,225	
Boats	205	$42,950
Apparatus		92,280
Shore property		55,800
Products.	*Pounds.*	
Shad	2,255,823	172,969
Herring	14,478,000	125,080
Sturgeon	114,400	1,144
Miscellaneous	513,200	50,620

*Fishermen and shoresmen.

3.—THE FISHERIES OF CHESAPEAKE BAY AND ITS TRIBUTARIES.

By Marshall McDonald.

1. GENERAL REVIEW.

The Chesapeake is a great highway for the commerce of the world. In contemplating its possibilities in this direction we are apt to lose sight of the fact that it is itself an area of vast and profitable production.

The fresh waters brought down by its grand system of tributary rivers, commingling with the salt waters of the bay, produce those peculiar conditions of salinity which are most favorable to the growth of the oyster. Consequently we find the shores of the bay itself, the mouths of all its rivers, and the bottoms of the tributary sounds—such as the Pocomoke and Tangier—thickly occupied by natural beds of oysters, the dredging of which furnishes profitable occupation for vast

numbers of the citizens of Virginia, Maryland, and other States. Many salt-water varieties of fish occur in the bay in countless myriads at their peculiar seasons, and furnish profitable and extensive fisheries. The most important species are the Spanish mackerel, two species of cynoscion, and the tailor or bluefish. In smaller quantities, also, are taken the sheepshead, drum, and porgy, and many other species of minor importance. Vast schools of menhaden frequent the bay from May to November, and, though not edible, are eagerly pursued and captured for conversion into oil and guano. Extensive manufactories for these purposes are in operation all along the bay, being more particularly abundant, however, on its western shore from the Rappahannock to the mouth of the Potomac. Northumberland County, Virginia, is the center of this industry. In the fisheries of the Chesapeake Bay are included those of Maryland and Virginia, and therefore the statistics of the commercial fisheries of those States, given in Census Bulletin No. 298, should be added together in order to show the aggregate production and value of the fisheries prosecuted in this important water area.

By this collation of figures we arrive at the following facts: Fishermen, 31,924; shoresmen, 1,884; factory hands, 11,064. This gives a grand total of 44,872 for persons employed in the Chesapeake fisheries.

The value of the apparatus, plus the capital otherwise invested, is $8,256,562.

The product amounts in pounds to 254,587,179, the value of which is estimated at $8,346,159.

2. THE JAMES RIVER.

PRESENT CONDITION OF THE FISHERIES.—The most southerly tributary of the Chesapeake is the James River, which rises in the heart of the Alleghanies and flows in a generally southeast direction, traversing more than 200 miles, through the mountains and the Piedmont section of Virginia, before reaching tide-water at Richmond, Va.

Prior to the establishment of obstructions in this river, caused by the construction of the James River and Kanawha Canal, large numbers of shad ascended the river as high as Clifton Forge and were taken in considerable quantities in fall-traps or "slides," in Jackson's and Cowpasture Rivers.

In the valley of Virginia west of the Blue Ridge seine fisheries were operated with profit, and the number of shad taken annually between Lynchburg and Richmond was at one time far in excess of the now entire catch for the whole river. The shad at the present time do not ascend higher than Bosher's Dam, about 9 miles above Richmond.

In the tide-water section of this river are received its two main tributaries, the Appomatox and the Chickahominy, which latter was, up to the time of the war, famous for its fine shad. The migrations of the fish into this river have not been limited to any appreciable extent by artificial obstructions. The erection of dams on the Appomatox at Petersburg has prevented the further ascent of fish, and consequently no organized fisheries are now prosecuted on that river.

During and long after colonial times large seine fisheries were operated all along the lower James. These have ceased to exist, only one small haul-seine—that at Harrison's Landing—being now in operation, gill-nets having almost entirely taken their place. A few pounds have been occasionally worked near the mouth of the river, but, being in defiance of law and unproductive in their results, have been discontinued.

The following is a summary of the statistics of the fisheries of the James River in 1880:

		Number.	Value.
Men employed		445	
Boats		264	$6,090
Apparatus and fishing houses			11,040
Products.			
Shad	pounds	357,000	14,280
Herring	do	850,000	10,200
Sturgeon	do	108,900	1,089
Miscellaneous	do	60,000	2,400

EARLY HISTORY OF JAMES RIVER FISHERIES.—*The following historical data are here reproduced through the kindness of Mr. Alexander Brown, of Norwood, Va.*

In 1743 old Dr. William Cabell bought a seine to catch fish, 6 feet deep in the middle, 4 feet deep at the staves or ends, well leaded and corked, about 15 fathoms long, and 100 weight of ¾-inch white cord.

[From the diary of Col. William Cabell, of "Union Hill," Nelson County, Virginia.]

1769.

October 3: Made up our fish dam, set trap, and caught several rockfish, tho' Mr. Hughes caught rocks a fortnight sooner. *October* 24: For several nights past caught 100 and large odd rockfish each night in our traps. *October* 25: Caught 2 fine carp in our traps.

1770.

April 10: Caught the first shad for this season.

November 23: Rented Jos. Cabell Ray's fishing place for £4 the next season.

December 18: By Jos. Cabell £5 for the rent of Ray's fishing place for 1770.

1771.

April 10: Begun to catch shad.

May 6: Humphrey to fish Thursday night. Mr. Nightingale to fish to-morrow fortnight.

1773.

June 7: By Abram Warwick a half Joe, which weighed 45 shillings, out of which I am to apply 10 shillings to his credit for a night fishing.

October 7: Rented John Depriest Ray's fishery as long as I have a right to it; so that it does not exceed nine years, to commence from the 25th Dec. next at £10 12*s.* 6*d.* a year, the first payment to be made the 10th of June next and the like sum annually.

1774.

July 19: By Col. Nevil 7*s.* 6*d.* for a night's fishing.

September 13: Caught a rockfish in one of my traps which was 2¼ feet long and weighed 10½ pounds.

1775.

March 11: Caught 17 white shad, 11 of which at one haul.

April 16: Caught a shad which weighed 7¼ pounds good weight.

May 15: Let Mrs. Prichard have 25 shad for her husband's mending my seein.

July 15: By Capt. Dawson, 14*s.* 2*d.* in full for 85 shad, at 2*d.* and 2*s.* 6*d.* for *Elliot Roberts for the Bostonians.*

1776.

July 15: Sent by Mrs. Prichard 16½ lbs. of twine to begin to knit me a seine.

1777.

March 30: At night caught shad for the first, being the first night that we began to fish. The river very low, scarcely a six hh'd tide, and has been so chiefly since Christmas. The dryest winter and spring, I believe, ever known.

1778.

March 21: Caught the first shad this season.

1779.

March 3: Rented my fishery on Wood's Island to James Matthews for theseason to find hima sceine and canoe, for 100£, to be paid at the end of the season, and to have the use of the sceine and fishery ten nights in the month of April, when I shall choose them. And he, the said Mathews, is to return the sceine and canoe at the end of the season, or *others of equal value in lieu thereof. Present, James Nevil and Nathaniel Watkins. March 31: Began to hall the* sceine, and caught ten shad, and delivered the sceine and fishing canoe to James Mathews all in good order. Present, Robert Hughes, Chas. Stewart, and many others.

April 2: At night there were 200 and odd shad caught at my fishery. *April* 10: Paid Mrs. Raly 25 shad, for which she paid me 4 dollars last Dec. *April* 18: In the morning finished fishing, and in 10 nights caught about 2,200 shad. *April* 28: By Chas. Stewart, $6 for 12 shad.

June 15: Charles Stewart, with one of my fellows and one of Landrum's, brought home my sceine, with many lead lost and much impaired by the cattle getting to it.

October 3: Caught 24 rocks in our traps, one of which weighed nearly 10 lbs., and had caught a few of a morning some time ago.

1780.

March 27: Begun to catch fish, 8 shad.

May 10: Sent Major Reid 47 shad in full of 65 which he paid me for some time ago (by negro Bob).

October 8: Caught a rockfish which weighed 12 lbs., and Hughes kept one that was much larger.

1781.

April 3: John Mays, James Mays, James Edmonds, John Layne, and Elijah Mays to have my sceine and fishing place on Wood's Island every Tuesday night during the present season for catching fish, for which they are to deliver me one-half they catch at my landing opposite the fishing place, to be careful of the sceine and keep it in good order; and if they fail to fish when the weather and river will permit, they are to be answerable to me for their neglect by paying me for one-half the fish, at the customary price, which are usually caught. At the end of the season to deliver up the sceine in good order. *April* 4: Moses Campbell, Ambros Campbell, Kellis Wright, Menos Wright, and John Alfred, same terms, every Wednesday night. *April* 5: J. Wright, C. Lavender, T. Largen, G. Wright, and J. Hollandsworth, every Thursday night caught in the course of the night 408 shad and fore some time past caught them very considerably. *April* 6: S. Edmunds and his company, same terms, every Friday night. Caught 473 shad in the course of the night. *April* 7: Sent Col. Sam'l Merideth, by Watt, his barrel with 200 pickled shad. *April* 8: James Mathews, with Col. Nevil's hands, to fish every Sunday or Monday night as shall be agreed between him and Capt. John Loving, on the same terms as the companies befor mentioned; at night caught 558 shad. *April* 13: At night the most severe frost I ever knew for the season. It has carried off all the fruit, killed most of our tobacco plants and those of all other kinds, destroyed our turnip and colewart seed in a great measure, and in short did every injury that frost could do. We caught at my fishery 64 shad, but when ever the sceine was a moment out of water it was frozen, and the water constantly froze to the poles while carrying the sceine out.

May 3: Caught 608 shad last night. *May* 4: Caught 508 shad last night. *May* 5: Caught about 400 shad last night. *May* 23: Declined fishing on account of the river rising; the fish tolerable good we caught the preceding night.

1784.

March 1: Wm. Ray (my tenant) to fish every Sunday night during the season and to deliver me one-half the fish that's caught, and am to find a sceine and canoe, and if he neglects to fish when the river and weather admit it, is to be answerable to me for each neglect; and Sam'l Edmunds & Co. same terms every Monday night, Jas. Edmunds & Co. every Tuesday night, Wm. Bibb & Co. Wednesday night, Killis Wright every Thursday night, Wm. Walton every Friday night.

April 13: At night caught 40 odd shad for the first, the winter being very severe and the spring very backward.

1785.

March 10: James Edmunds & Co. to fish every Monday night at my fishery, on Wood's Island, during the season, for one-half the fish he catches. Sam'l Edmunds & Co. Tuesday night, with Wm. Bibb & Co. Wednesday, do.; Killis Wright, do. Thursday, do.; Wm. Walton & Co. Friday, do.; Rich'd Murrow Saturday, do.; Young Landram Sunday, ditto.

April 15: Caugh 76 shad, for the first this season.

May 9: Monday night John Ball failed to haul my seine at the Swift Island, and the weather very good; to be answerable for the same. *May* 16: Paid Rich'd Murrow, jr., £3 for netting a seine in the presence of his father, Sam'l J. Cabell, and others.

1786.

February 11: James Brown, Wm. Key, Wm. Singleton, John Gregory, and Chas. Taylor to fish at Wood's Island every Sunday night (same terms as above); Sam'l Edmunds & Co., Monday do.; Jas. Edmunds & Co., Tuesday do.; Thos. Jopling & Co., Wednesday do.; Killis Wright, Thursday do.; Wm. Walton, Friday do.; James Mathews, Moses Ray, John Bibb, &c., &c., on same terms, &c., &c., at Swift Island fishery.

March 29: At night hauled the seine but caught no fish; Wood's Island. *March* 30: Caught 3 shad; the first. *March* 31: Caught 9 shad; the eveling very wet and windy.

April 14: Caught 180 shad at the Swift Island; the first this season. *April* 15: Caught 177 shad at the Wood's Island fishery. *April* 16: Caught 930 shad at the Swift Island fishery. *April* 17: Caught 500 shad at the Wood's Island fishery. *April* 18: James Mathews caught 1,262 shad at my Swift Island fishery; James Edmunds caught 680 shad at my upper fishery (Wood's I.). *April* 19: Thos. Jopling, jr., John Ball & Co., 1,203 shad at my upper fishery (Wood's Island); Wm. Johnson & Co., 1,304 shad at my fishery (Swift Island).

May 4: Paid Nathan Ward 30 shillings pr. order of Rich'd Murrow jr. for netting one-half the seine at the Swift Islands.

1787.

March 25: Yesterday and to-day about 300 shad were caught at my Swift Island fishery.

April 8: Caught a shad at my fishery on Wood's Island which weighed 8½ lbs. good weight.

May 14: Declined hauling the seine; having from the 25th of March been engaged in that business with out ever being interrupted by rain or high water. A most excellent season for fishing.

August 14: Sent Dr. Geo. Gilmer a bbl. of pickle shad (150) by his man John.

October 6: In the morning took a rockfish out of our traps that weighed 12 lbs.

1788.

February 14: John Bibb to fish at my Swift Island fishery every eighth night during the season, with a good gang, &c. (other contracts as above).

April 4: Caught 18 shad at the Swift I.; the first this season.

May 16: John Boush failed to fish at night, the river and weather favorable, and fish plenty. James Mathews failed at Swift Island, do.

1789.

March 29: At night caught 12 shad at Wood's I.; the first this season. *March* 30: At night caught 52 shad at Wood's I.; at night caught 330 shad at Swift Island.

April 2: At night caught 709 shad at Swift Island.

September 29: Let out fish-traps and caught a few small fish in the night.

1790, 1791.

March 27, 1790: Begun to catch shad.

May 15, 1791: Declined fishing, very few being caught, tho' very good. A very unfavorable season for fishing, the river having been very low.

1792.

April 2: Caught the first shad this season. *April* 28: Just beginning to catch fish, having been prevented by high water, except two nights, in the course of the season.

May 3: Caught at Wood's I. 1,016 shad last evening. *May* 16: Edward Harding and his co. failed to fish at Swift Island; the fish very good, and upward of 100 caught by the proceeding company. *May* 20: Declined hauling the seine at Wood's I. When we caught upwards of 100 a night, and some of them tolerable good. *May* 25: At night, old Mr. Smith hauled his seine at Wood's I. and caught upward of 100 shad, which were mostly tolerably good.

September 29: Set our fish-trap, but the dam not secure.

1793.

March 24: At night caught 70 or 80 shad at Woods I.; might have caught several days sooner had the river not been too high.

November 5: Caught a rockfish in the Swift Island trap which weighed 16 lbs.

1794.

March 21: Began to catch fish.

May 15: Declined hauling my seine, having caught none of any consequence for some days past; it has been a very bad season for fishing altogether.

1795.

April 2: At night caught a few shad; the first this season.

May 18: Declined hauling my seine, altho' what few are caught are tolerable good. There have been the fewest and smallest shad caught this season of any within my remembrance.

Swift Islands are about 1 mile above Midway Mills and 102 miles above Richmond, via James River as it meanders.

Wood's Island, now known as Norwood Island, 10 miles above Richmond, via James River as it meanders, the largest and uppermost of the Swift Islands, containing 9 acres, where there was a most excellent fishery, was granted to Moses Ray, by patent bearing date December 15, 1749. Moses Ray died in 1766, and Col. William Cabell, sr., administered on his estate, and bought the said fishery from the heirs in October, 1784.

Buffalo Island, containing 40 acres, was patented by Dr. William Cabell in 1738, and deeded to his oldest son Col. William Cabell, of Union Hill, in 1763, first called *Buffalo Island*, then *Wood's Island* then *Upper Fishery*, then *Hughes Island*, and *now* Norwood Island.

From a memorandum of Col. William Cabell, jr. (the son of Col. William Cabell, sr., of Union Hill), who had recently married and had just begun to keep house:

1787.

March 24: 40 white shad were taken at one haul at the Swift Islands. *March* 28: Received 20 white shad from Swift Island fishery. *March* 30: Received 26 white shad from Swift Island fishery.

April 1: Received 51 white shad from Swift Island fishery. *April* 5: Received 32 white shad from Swift Island fishery. *April* 9: Received 37 white shad from Swift Island fishery. *April* 10: Received 30 white shad from Swift Island fishery. *April* 13: Received 15 white shad of my father. *April* 14: Received 50 shad, 39 of which I sent up to my quarter. *April* 24: Received 20 white shad of my father. *April* 25: Received 19 white shad of my father. *April* 28: Received 49 white shad of my father.

May 9: Received 20 white shad of my father.

1788.

April 4: Began to catch white shad.

From Col. William Cabell sr's. account books I find that fresh shad sold at 2 to 4 pence each, before and after the revolution. During the war prices varied with the currency.

Pickled shad in barrels, containing from 150 to 200 shad, sold for about $6 to $9 a barrel. Very few shad, fresh or pickled, were sold, but very many were given away.

3. YORK RIVER AND ITS TRIBUTARIES.

The York River is the common estuary of the Pamunkey and Mattapony Rivers, which have their confluence at West Point, about 20 miles west of Yorktown and Gloucester Point.

The area of the hydrographic basin drained by the tributaries of the Mattapony and Pamunkey is small compared with that of any of the principal rivers of the State; yet, in consequence of not being obstructed for some distance above the head of tide, the actual spawning area for shad and herring is greater than in the James, the Rappahannock, or even in the Potomac. The fact that these waters have been able to maintain a respectable shad fishery, in spite of the excessive drafts made upon them, clearly illustrates the disastrous influences exerted upon the fisheries of our principal rivers by the obstructions which restrict the migrations of the shad and herring (alewife) to the tidal areas.

Even in these rivers there has been a steady decrease in the value and the production of these fisheries. The herring fishery no longer exists. Probably 250,000 to 300,000 are taken in gill-nets for local consumption. Formerly with a haul-seine, upon a single tide, over 100,000 have

been taken. Now, the haul-seines are abandoned, there being but four in the two rivers, and the fishing is mainly with float-seines. The fish reach the market through West Point, Sweet Hall, Lester Manor, Cahoke, and White House, all stations on the York River Railroad, and thence are sent chiefly to Richmond, and some to Baltimore and Philadelphia. Sturgeon go to Richmond almost exclusively, and are known there as Charles City "bacon".

Summary of the fisheries of the Mattapony and Pamunkey Rivers for 1880:

Pamunkey and Mattapony Rivers.

	Number.	Capital invested.	Product of the fisheries.	
			Pounds of fish.	Value.
Men employed in fishing	425			
Boats	212	$3,920 00		
Apparatus		4,020 00		
Fishing houses and other shore property		425 00		
Products.				
Shad			238,850	$11,947 50
Herring			250,000	2,500 00
Sturgeon			51,661	1,549 83
Other fresh-water fish			25,000	2,000 00
Total		7,365 00	565,511	17,997 33

The fish for market are taken almost exclusively in float-nets and stake-nets; formerly there were a number of profitable seine hauls in both rivers, which are now abandoned. Four of the old shores are sometimes hauled, but they hardly pay expenses. Upon the two rivers one hundred and seventy-five boats are occupied in fishing float-nets and twenty-five boats in stake-net fishing. To each boat there is usually a man and a boy, and the cost of the outfits will average about $30.

Besides the float and stake-nets, there are three weirs in the vicinity of West Point and eight fyke-nets. They are principally valuable for the fall and winter fishing.

At the narrows of the rivers what are termed "hedgings" are numerous. They effectually impede the further ascent of the fish, and as nearly all the shad that reach them are ripe they must exert a very injurious influence upon the fisheries.

A "hedging" is made by driving down forks at intervals of 6 to 8 feet across the stream from one bank to the other. These support a continuous log or ridge-pole some 6 or 8 inches in diameter; resting upon this and pointing up the stream are poles 3 or 4 inches in diameter driven into the mud and spaced at intervals of an inch. An opening about 3 feet in diameter is left at one point. By the accumulation of leaves a tolerably tight dam is soon formed; the water is dammed back, and a strong current discharged through the opening, presenting the only possible passage for the ascent of the fish. At this opening stands a worthless, lazy contraband, or more worthless white, "skim-net" in hand, and when he feels a fish strike the net lifts it out. Such devices as these should be prohibited under the severest penalties.

4. THE RAPPAHANNOCK RIVER.

The sources of the Rappahannock are on the eastern slope of the Blue Ridge. Its mountain tributaries formerly abounded in trout, which have, however, almost entirely disappeared from most of the streams, being occasionally found in those above where the fishing laws have been strictly observed. The readiness with which these fish have been restored to their streams by

artificial planting proves that their disappearance was due not to any change in the character of the water, but merely to over-fishing. Before obstructions existed in the Rappahannock the shad ascended its main tributaries almost to the base of the Blue Ridge. Contests relative to the obstruction of the stream by dams began in colonial times, and petition after petition for arresting the encroachments of mill owners and manufacturers upon the general right was filed in the House of Burgesses. As is, however, usual, the march of progress triumphed, and the "annually recurring bounty of Providence," *i. e.*, the fish, was entirely cut off from the upper waters of the river. At the present day the upward movement of shad is limited to Falmouth—a short distance above tide-water—where a stone dam 20 feet high prevents further ascent. Here, as on most of the rivers, we hear the same well-grounded complaint of impoverished fisheries, due, however, as a rule, first to the diminished spawning and breeding area of the shad, and, secondly, to too excessive fishing by illegitimate appliances, such as traps and slides, the use of which above high water should in all cases be absolutely prohibited by law.

Organized fisheries are prosecuted in this river as high as Fredericksburg—about 140 miles from its mouth—where tide-water ceases. From the bay up to Bowler's wharf fishing is carried on almost exclusively by pound-nets. Thence to Leaton's stake-nets prevail. Each staker fishes from twenty-five to fifty nets, each about 9 yards long, with a stretched mesh of 4½ to 5 inches, the depth of the net varying with the depth of water. Three haul-seines are fished between Bowler's and Leaton's. From Leaton's to Fredericksburg the haul-seines and the gillers hold disputed sovereignty. During the season of 1879 nine seines in all were fished on this river. These were operated by horse power, and averaged about thirteen men to a crew.

The statistics of the *personnel* of these fisheries for the season of 1879, the capital invested, the products and their value, are given in the following table:

The Rappahannock River.

	Number.	Value.
Men employed	416	
Boats	180	$5,335
Apparatus and fishing houses		33,638
Products.		
Shad ..... pounds..	469,073	18,762
Herring ..... do....	732,797	8,793
Sturgeon ..... do....	37,700	177
Miscellaneous fresh-water fish .... do....	107,859	7,549
Offal, scrap fish* ..... bushels..	5,100	765

* Used for manure.

5. THE POTOMAC RIVER.

The Potomac River has its sources upon the eastern front of the main chain of the Appalachians; flowing south and east, it breaks through the Blue Ridge at Harper's Ferry and reaches tide-water five miles above Washington, by descending in rapids over a granite ledge about 60 feet high, known as the Great Falls. By its main tributary, the Shenandoah, which joins the Potomac at Harper's Ferry, it drains the rich valley of Virginia as far up as Staunton, which is on the divide between the waters flowing into the James and the Potomac.

The Potomac has always been celebrated for the excellency and value of its shad and herring fisheries. Reports of their magnitude have come to us from early days, and from them we gather that the production must then, as compared with our own day, have been simply fabulous. While

the Potomac and its tributaries above tide-water present all the conditions suitable for the spawning and breeding grounds of the shad, yet the Great Falls have always stood as an insuperable barrier to the further upward migrations of not only the shad and herring, but also of the more enterprising species, the rock-fish or striped bass. The fisheries of this river annually decreased in value and production up to the time of the war; the intermission which then ensued in the fishing operations on account of those of a martial character allowed the fisheries to recuperate, so that in the years immediately succeeding the war it was found that they had in a measure recovered from their former depletion. In 1878 the minimum of production was attained, during which season less than 200,000 shad were taken in the entire river. In 1879 the results of previous artificial propagation first manifested themselves, and there was a considerable increase in the run of shad, from which time the shad fisheries steadily increased, until in the season of 1880 nearly 600,000 were taken.

The early fisheries on the Potomac were prosecuted entirely by means of haul-seines. About the year 1835 gill-nets were introduced from the North. These have steadily grown in favor and for the last few years have been the principal instrument employed for the capture of shad.

In 1880, only eleven large haul-seines were in use where fifty had been fished in early days. Within the last five years pound-nets have been introduced. They are increasing in numbers rapidly, and are by degrees displacing the gill-nets, which, as above stated, displaced the haul-seines.

The following statistics show the extent and value of the Potomac fisheries for 1880:

The Potomac River.

	Number.	Value.
Men employed	1,208	
Boats	230	$30,750
Apparatus and fishing houses		209,550
Products.		
Shad ..... pounds	2,040,052	60,201
Herring ..... do	6,201,252	62,912
Sturgeon ..... do	283,000	2,880
Miscellaneous ..... do	1,317,638	39,510

6. THE SUSQUEHANNA RIVER.

The sources of this river are in the highlands of Pennsylvania and Western New York. Flowing in a general southerly direction, it breaks through the entire Appalachian system, and discharges into the head of Chesapeake Bay. Its principal tributaries are the Juniata, the North Branch, and the West Branch. The extreme sources of the North Branch are in the Catskill Mountains, while the western branch interdigitates with the headwaters of the Ohio. In the early settlement of the country the abundant run of shad into all these streams at the proper season was a matter of prime importance to the people, a very considerable proportion of their income being derived from this source. Profitable shad-fisheries existed at a number of points on the Juniata and on the North Branch of the Susquehanna, and vast numbers ascended the West Branch also up into the Chenango River in the State of New York, and were taken at a distance of several hundred miles above their present limit. The accounts in regard to abundance of shad, given by the early settlers on all the rivers of the Atlantic slope, seem almost fabulous to us in these days. If tradition has invented exaggerated stories concerning all the other rivers, those accounts touching the Susquehanna at least are undoubtedly established by authentic data. At the request of Prof. S. F. Baird, U. S. Commissioner of Fish and Fisheries, a

committee of the Wyoming Historical and Geological Society, of which Mr. Harrison Wright was chairman, has prepared and submitted the following very interesting report on the early shad-fisheries of the North Branch of the Susquehanna River.

REPORT OF A COMMITTEE OF THE WYOMING HISTORICAL AND GEOLOGICAL SOCIETY ON THE EARLY SHAD-FISHERIES OF THE NORTH BRANCH OF THE SUSQUEHANNA RIVER.

Prof. SPENCER F. BAIRD,

United States Commissioner of Fisheries:

SIR: The committee of the Wyoming Historical and Geological Society, to whom your inquiries touching the old shad-fisheries on the North Branch of the Susquehanna were referred for investigation, would respectfully report that they have interviewed, by letter or in person, a large number of the old settlers, who either now live or formerly did live near the banks of the river, and were calculated to be able to give the requisite information, and who were pleased to report. These persons have, in nearly every instance, most cheerfully and at no little trouble furnished us with the information asked. We make this acknowledgment for the reason that the parties to whom application was made are necessarily far advanced in age, all with but one or two exceptions having seen their "three score years and ten," and to them it was no little labor to write out their reminiscences of the early shad-fisheries.

Besides these interviews, the records of the county, files of old newspapers, the numerous printed histories of this section of country, have been consulted, and from these various sources the data upon which this report is based have been gleaned. With these preliminary remarks let us proceed to our report.

HISTORY.—There can be no doubt but that the Indians, for years before the white people thought of settling at Wyoming, caught their shad there in large quantities; their net-sinkers, though they have for years been collected by archæologists, are still very plenty, and can be found anywhere on the flats along the river in quantities, and the fragments of pottery show unmistakable markings with the vertebræ of the shad; these, together with the fact that the early settlers saw the Indians catching shad in a seine made of bushes (called a bush-net), point to the fact that *shad on the North Branch were taken in quantities by the Indians.*

The Connecticut people who settled here over a hundred years ago had, in the very start, their seines, and took the shad in numbers; as near as we can learn they were the first white people who seined the shad in the North Branch.

During the thirty years' war which the Connecticut settlers had with the Pennsylvania Government for the possession of this valley of Wyoming, the shad supply was a great element of subsistence; for this, unlike the fields, barns, and granaries, could not be burned by the Pennamites. An old settler says: "When we came back to the valley we found everything destroyed, and the only thing we could find to eat were two dead shad picked up on the river shore; these we cooked, and a more delicious meal was never partaken of by either of us." One of the most bitter complaints *made against the Pennamites, in 1784, was that they had destroyed the seines.*

After the Revolutionary war had ended, and the troubles between the Pennsylvania claimants and the Connecticut settlers had been quieted, the shad fisheries increased in numbers and value yearly, until about the year 1830, when the dams and canal were finished and an end put to the shad fisheries.

RUN.—It would appear, from the papers hereto attached, that the male fish preceded the female fish by some eight to ten days in their ascent of the river, and between the ascent of the former and that of the latter there was generally a perceptible rise in the river, and immediately following it came the large roe-weighted females in great schools.

FISHERIES.—Accompanying this report is a map of the Susquehanna River from the junction of the West Branch at Northumberland to Towanda, near the New York State line; upon this is noted the localities of the fisheries with as much accuracy as was attainable from the accounts received by us. Some have probably been omitted, especially in the stretch of river from Danville to a point 4 miles above Bloomsburg, where we were unsuccessful in our inquiries, but without doubt the most important on the river have been recorded by us.

At Northumberland, or just below, was Hummel's fishery; between Northumberland and Danville there were eight fisheries in order from Northumberland up, as follows: (1) Line's Island lower fishery; (2) Line's Island middle fishery; (3) Smith's fishery; (4) Line's Island upper fishery; (5) Scott's fishery; (6) Grant's fishery; (7) Carr's Island fishery; (8) Rockafeller's. The next fishery of which we have a record was the fishery of Samuel Webb, located about 4 miles above Bloomsburg. Above this point about 4 miles, and 6 miles below Berwick, was the fishery of Benjamin Boon; the next was located just above the town of Berwick, and about a mile and a half above Berwick was the Tuckahoe fishery (this last is the same as the Nescopeck fishery mentioned in Pearce's history); the next was at Beach Haven. Between this latter place and Nanticoke Dam there were three, viz, one at Shickshinny, one just below the mouth of Hunlock's Creek, and one called the "Dutch" fishery, on Croup's farm. Above Nanticoke there was one belonging to James Stewart, about opposite Jameson Harvey's place; one at Fish Island, and one at Steel's Ferry, called the Mud fishery. The next was on Fish's Island, three-quarters of a mile below the Wilkes-Barre bridge; the next was Bowman's fishery, immediately below the Wilkes-Barre bridge; the next was the Butler fishery, a little above the bridge; the next was at Mill Creek, a mile above the bridge; the next was the Monocacy Island fishery; the next Carey's; the next was on Wintermoot Island, this last landing on the left bank above the ferry at Beauchard's; the next was at Scovel's Island, opposite Lackawanna Creek; this and the Falling Spring fishery next above belonged to parties living in Providence, away up the Lackawanna. The next above was at Harding's, in Exeter township; the next above was at Keeler's, in Wyoming County; the next was at Taylor's (or Three Brother's) Island. This latter fishery was no doubt the one referred to by P. M. Osterhout as being opposite McKune's Station on the Lehigh Valley Railroad. The next was at Hunt's ferry *circa*, 5 miles above Tunkhannock; the next was Grist's Bar, about a mile above Meshoppen; the next was at Whitcomb's Island, a mile below Black Walnut bottom; a half a mile above this fishery was the Sterling Island fishery; and the next above was Black Walnut, and half a mile further up was the Chapin Island fishery; the next was at the bend at Skinner's Eddy; the next was at Browntown, in Bradford County; the next was at Ingham's Island; the next was at the mouth of Wyalusing Creek; 2 miles farther up was one at Terrytown; the next and last that we have any record of was at Standing Stone, about 6 miles below Towanda.

Thus it will be seen that between Northumberland and Towanda there were about forty permanent fisheries.

MONEY VALUE.—Our country records only go back to 1787. We spent a whole day in searching the first volumes, in hopes that we might find some entries of transfers of fishing rights, but our search was fruitless; we have, however, found among the papers of Caleb Wright a bill of sale of a half interest in a fishery between Shickshinny and Nanticoke, called the "Dutch fishery;" the price paid was £20 "lawful money of Pennsylvania," equivalent to $53.33.*

Jameson Harvey says that Jonathan Hunlock's interest in the Hunlock fishery was worth from $500 to $600 per annum; it was a half interest. Henry Roberts says a right in a fishery was worth from $10 to $25.

*Caleb Wright's son received 1,900 shad as his share of one night's fishing at this fishery.

Major Fassett's father was one of eleven owners in the Sterling Island fishery, and his interest was valued at $100.

Mr. Hollenback's information on the money value of the different fisheries is by far the most valuable; he says the Standing Stone fishery was worth from $300 to $400 per annum; the Terrytown fishery was worth about the same; the Wyalusing Creek fishery was worth about $250 per annum; the Ingham Island fishery, $50 less; the Browntown and Skinner's Eddy fisheries, about $150 per annum each.

Jameson Harvey say: "The widow Stewart, at the Stewart fishery, used often to take from $30 to $40 of a night for her share of the haul."

The data bearing upon this point are decidedly unsatisfactory, as they would only give to the forty fisheries an annual value of about $12,000, a large amount for those days, yet one we believe to be too small; the next item, the "catch," should be taken with this one to form a basis for calculation.

CATCH.—At the eight fisheries near Northumberland large numbers of shad were taken; three hundred was a common haul; some hauls ran from three to five thousand. The Rockafeller fishery, just below Danville (about the year 1820), gave an annual yield of from three to four thousand, worth from 12½ cents to 25 cents apiece.

Mr. Fowler says that the fishery just above Berwick was one of the most productive, and that he has assisted there in catching "thousands upon thousands," but does not give the average annual yield; he also says, that at the Tuckahoe fishery "many thousands were caught night and day in early spring;" and at the Webb and Boon fisheries the hauls were immense; at the latter they got so many at a haul that they couldn't dispose of them, and they were actually hauled on Boon's farm for manure.

At Hunlock's fishery the annual catch must have been about ten thousand.

At the Dutch fishery in one night thirty-eight hundred were taken.

At the Fish Island fishery, at a single haul, nearly ten thousand shad were taken.

Mr. Jenkins recollects of seeing a haul at Monocacy Island—just before the dam was put in—of twenty-eight hundred.

At Scovel's Island the catch was from twenty to sixty per night; at Falling Spring fifty to three hundred per night; at Taylor's Island from two hundred to four hundred per night.

At Wyalusing the annual catch was between two and three thousand; and at Standing Stone between three and four thousand.

The daily catch at the Terrytown fishery was about one hundred and fifty.

Major Fassett says that at the Sterling Island fishery "over two thousand were caught in one day in five hauls."

It is a plain deduction from the above facts that the fisheries down the river were much more valuable than those above. Above Monocacy we hear of no catch over two thousand, while below that point they were much larger, and while from $300 to $400 seems to be the general annual value above, we find the fishery at Hunlock's, 12 miles below, was worth from $1,000 to $1,200 per annum. The shad farther up the river appear to have decreased in numbers yet to have increased in size, and that brings us to the next head.

SIZE.—The opinion seems to be general that the great size attained by the Susquehanna shad was attributed to the long run up the fresh-water stream (carrying the idea of the survival of the fittest); that they were of great size is beyond doubt; nearly every one who recollects them insists on putting their weight at almost double that of the average Delaware shad of to-day.

Mr. Van Kirk gives from 3 to 9 pounds as the weight of the shad caught at the fisheries in Northumberland and Montour Counties.

Mr. Fowler says he has assisted in catching thousands weighing 8 and 9 pounds at the fisheries in Columbia County.

Mr. Harvey, speaking of the Luzerne County shad, says: "Some used to weigh 8 and 9 pounds, and I saw one weighed on a wager which turned the scales at 13 pounds."

Major Fassett, speaking of those caught in Wyoming County, says: "The average weight was 8 pounds, the largest 12 pounds."

Dr. Horton says of the shad caught in Bradford County, that he has seen them weighing 9 pounds; ordinarily the weight was from 4 to 7 pounds.

PRICE.—The price of shad varied, according to their size, from 4*d.* to 25 cents, depending of course upon their scarcity or abundance, and as some of our correspondents remember the price in years when it was high, and others in those when there was a great plenty of fish, there arise what appear to be conflicting statements in their letters.

At the town meeting held at Wilkes-Barre, April 21, 1778, prices were set on articles of sale, *inter alia*, as follows: Winter-fed beef, per pound, 7*d.*; tobacco, per pound, 9*d.*; eggs, per dozen, 8*d.*; shad apiece, 6*d.* At one time they brought but 4*d.* apiece. A bushel of salt would at any time bring a hundred shad.

At the time the dam was built they brought from 10 to 12 cents. On the day of the big haul Mr. Harvey says they sold for a cent apiece (Mr. Dana says 3 coppers).

Mr. Isaac S. Osterhout remembers a Mr. Walter Green who gave twenty barrels of shad for a good Durham cow.

Mr. Roberts says that in exchanging for maple sugar one good shad was worth a pound of sugar; when sold for cash shad were worth 12½ cents apiece.

Major Fassett says the market price of the shad was $6 per hundred.

Dr. Horton says the shad, according to size, were worth from 10 to 25 cents.

Mr. Hollenback, in calculating the value of fisheries near Wyalusing, has put the value of the shad at 10 cents apiece. In 1820 they were held in Wilkes-Barre at $18.75 per hundred. Mr. Fowler says they were worth 3 cents or 4 cents apiece.

COUNTRY SUPPLY AND TRADE.—Every family along the river having some means had its half barrel, barrel, or more of shad salted away each season, and some smoked shad hanging in their kitchen chimneys; not only those living immediately along the river were the beneficiaries, but the testimony shows that the country folk came from 50 miles away to get their winter supply, camping along the river's bank, and bringing, in payment, whatever they had of a marketable nature. They came from the New York State line, and from as far east as Easton, bringing maple sugar and salt, and from as far west as Milton, bringing cider, whisky, and the two mixed together as cider royal, and from down the river, and away to the south towards Philadelphia, bringing leather, iron, &c.

Mr. Isaac S. Osterhout says when quite a boy (1822–'23) he went with a neighbor to Salina, N. Y., after salt, he taking shad and his neighbor whetstones, which they traded for salt. The teams hauling grain to Easton brought back salt; in good seasons the supply of this latter important item always seems to have been short of the demand.

The shad, as far as we can learn, appear never to have gone up the West Branch in such quantities as they did up the North Branch, and the same may be said of the Delaware, or else the fish were of inferior quality, for the dwellers from the banks of both of these streams came to Wyoming for their supply of shad.

Mr. P. M. Osterhout tells of a firm (Miller & McCord) living at Tunkhannock which did quite an extensive business in shad, sending the cured ones up the river into New York State, and far down the river.

Mr. Fowler says: "No farmer, or man with a family, was without his barrel, or barrels, of shad the whole year round. Besides furnishing food for the immediate inhabitants, people from Mahantango, Blue Mountains, and, in fact, for 50 miles around, would bring salt in tight barrels, and trade it for shad."

Mr. Harvey says: "Boats coming up the river used to bring leather, cider, whisky, cider royal, salt, iron, &c., and would take back shad."

OTHER FISH.—We do not find that any other deep-sea fish (with the exception of eels) ever came up the river above Northumberland. The "Oswego bass," "Susquehanna salmon," "Yellow bass," "Striped bass," "Susquehanna bass" spoken of by the different correspondents appear to be the same fish, which is also sometimes called the wall-eyed pike; an excellent fish introduced into the river many years ago from Oswego Lake; they are not now as plenty as formerly, though within the past few years they have been increasing perceptibly. The other fish mentioned are nothing but the common river fish.

EFFECT OF DAMS.—There is no question that the building of the dams necessary to feed the canals put a stop at once to shad fishing; all our correspondents agree that after the Nanticoke dam was finished, in 1830, no shad were ever caught above it. As to the effect of the dams on the shad fishing, the following extracts from Hazard's Register are of interest:

1829. May 9, page 301. "Lewiston, Pa., May 2. It is stated that shad are caught in much greater abundance below the dam at North Island, in the Juniata, than has ever been known at any previous time. It is supposed that the dam in the Susquehanna, immediately above the mouth of the Juniata, has the effect of directing their course up the Juniata. The dam at North Island retards their passage farther, and the consequence is that the people farther up the Juniata are deprived of the luxury of fresh shad, which so abundantly falls to the lot of their neighbors a few miles lower down. But we must be content with these little deprivations by the promise of the immense advantages which are to accrue to the country from the canal."

1830. May 8, page 304. The Sunbury Beacon of Monday the 26th of April, says: "Not less than from 4,000 to 5,000 shad were caught on Saturday last within a quarter of a mile below the dam. Upwards of 500 were taken by one dip-net, and several others averaged 200 and 300 each. We understand that several hundred were caught with dip-nets yesterday."

1831. May 14, page 318. From the Wyoming Herald: "Wilkes-Barre, May 6, 1831. While the raftsmen complain of the Nanticoke dam, the boys find in it a source of amusement. The bass which ascend at this season in great numbers, stopped by the dam, offered fine sport. Indeed, hooks, half a dozen at a time without bait, are let down and suddenly drawn up often with two or three bass hooked by the side."

And on the same page, from the Susquehanna Democrat: "A short time since great quantities of bass were caught in a small eddy formed in the river directly below the abutment of the Nanticoke dam. The fish apparently lay there in schools, and by drawing hooks through the eddy numbers were caught. On Thursday and Friday last a number of fine shad were caught in the same way. One man drew out 9 in one day, and sold them for 50 cents each. This is the first instance within our knowledge of shad being caught with a hook. We mention the fact as one altogether new, as well as to say to the down-river folks, our market has not been altogether destitute of shad, though many a gentleman's table has."

We are informed that to-day the shad manage to get over the Columbia dam, only to be received in nets spread for them at the head of the sluice-way by a pack of scoundrels, among whom, if we hear correctly, are parties connected with our State fish commission; if it were not *for this we would have shad in small quantities as far up as the next dam at all events.* The cutting off of this staple of food from tens of thousands of people in this section of country could not but be a great loss, and it has been questioned if it was not greater than the benefits derived from the great internal improvements. Some slight improvements in the sluice-way of the lower dams and a regular ladder-way in that of the Nanticoke dam, good protective laws, well enforced *(with a double-barreled shot-gun for Columbia dam), certain days set for fishing along the river,* and one good stocking with young shad, would, we believe, give us shad in fair quantities all the way up the river.

We do not believe the expense would be very great, whereas the benefits would be incalculable. There is no doubt that the experiment is well worth trying.

Luzerne County will contribute her share towards the necessary improvements.

All of which is respectfully submitted.

HARRISON WRIGHT,
Chairman of Committee.

WILKES-BARRE, *May 27, 1881.*

PRESENT CONDITION OF THE FISHERIES.

LIMITS OF THE FISHERIES.—The present limit of the upward movement of shad in this river is Columbia, situated about 40 miles above tide-water. The dam at this place, about 6 or 7 feet high, constitutes an effectual barrier to the passage of the fish. To this point shad still ascend in large numbers, *from 30,000 to 40,000 being annually taken at the dam or in its immediate vicinity.*

Herring now ascend the Susquehanna only as far as Bald Friar, a few miles above tide-water, nor have we any information of their ever having pushed their migrations beyond this point.

SEINE-FISHING.—Rock and perch are taken in large numbers in haul-seines during the spring months. In summer and fall these fish are taken exclusively with gill-nets and small drag-nets.

Catfish are taken in great quantities for the Philadelphia market, where, dressed, they command a price per pound not much below that for perch and rock.

The most important fishing industry on the Susquehanna is the gill-net fishing, though twenty large haul-seines are operated at various points, in what is termed the "head of the bay," the North-east River, and in the Susquehanna itself, a short distance above Havre de Grace. In consequence *of the peculiar natural characteristics of the fishing grounds of this river, the landing of the seines* is provided for by special constructions. In some places large floats are used on which to land the seines. These are fully described in the section relating to the apparatus used in the capture of fish. In other cases, instead of floats, a "battery" is built of logs; this is filled in with earth and stones, and upon it the seine is landed.

GILL-NET FISHING.—In the gill-net fisheries, which are frequently conducted in very rough water, boats larger and far more seaworthy than those used on other rivers are here employed. A complete outfit for a giller is one round-bottom boat, costing, when new, $140; one scow with house and reel, $40; and four or five 100-fathom nets, costing about $25 each, making a total value of about $300.

The following graphical description of the mode of fishing these nets is from the pen of the late Professor Milner:

"The 'gilling ground' extends from Havre de Grace, Md., eastward and southward, to the mouth of the Chester River. Between Havre de Grace and Spesutie Island *a shoal extends* with the navigable channel to the westward, and to the eastward an old partially filled up chan-

nel known as Swash. Near the center of the shoal a light house has been built, called Battery Light. When the shad have reached this point in the bay, they come up on the shoal in the night, at slack water of ebb and flood of tide. From the Battery Light to head of the island is known to be the center of their congregation, and a great strife for good berths prevails, so much so that enterprising fishermen will lie in their boats for half a day, anchored to the spot where they desire to cast the nets after dark. These drift-nets are made of fine twine and entangle the fishes by the gill-flaps as they swim against them. The cork-line floats at the surface, and the lightly weighted lead line at low tide trails along the bottom. At each end of the nets, which have ordinarily a length of 300 yards, a float is tied, upon which rides a lantern. These lanterns are required to distinguish the different nets as they are cast along the shoal parallel to each other, often with not more than 50 or 60 feet intervening. They drift with the tide, and one floating too slowly or snagged at the bottom becomes fouled with its neighbor as soon as it is overtaken. It is essential that all are put out simultaneously, or the dividing spaces soon become irregular, and many of them too narrow, resulting in the nets becoming entangled with each other. A still night on the bay, in the height of season, is a pleasant experience. The anchored boats, scarcely discernible in the dusk, become deep shadowy masses at intervals or disappear in the darkness. Suddenly a muffled, quiet movement of oars is heard, and in quick succession lights appear on the water in a long line, and the rapid movement of a hundred pairs of oars is heard as they click in the rowlocks. Each rower vies with his rival to run out the 300 yards of net, his comrade in the stern rapidly and skillfully throwing the corks and leads. Some impatient fellow usually pulls up his anchor silently, but the light on the water telegraphs the fact to the rest and he rarely gets half a dozen strokes ahead. One hundred boats often pull abreast across the line of the shoal. The second lantern floating on the water announces the net all out.

"Standing in the night on an elevated point of the island, with many hundred lights strewn thickly over the wide expanse of water, the observer is impressed with the similarity of the view above him and below, as if the stars overhead were reflected on the surface of the bay with double brilliancy.

"The boatman either turns directly back and 'runs the net,' passing the cork line through the hands, readily detecting the presence of fish, or he rows back to the starting point, and it is run from that end, the net all the time drifting with the tide. The shad, whenever found, are 'ungilled' and thrown into the boat, and the net drops away again.

"The necessity for instantly going over the net relates to the presence of great quantities of eels, which soon spoil the shad for the market or for the table. Sitting in my boat while the oarsman was quietly rowing behind a 'giller' we were attracted by a continual splashing in a net near by. We thought it to be a sturgeon rolling and entangling himself in the twine as they sometimes do. Heading the boat in the direction of the sound and coming near, it seemed at first to be a number of 'herring' meshed in a singularly close huddle, and in their struggles flashing their white sides in the dim starlight. As we came nearer I turned the light of the lantern full upon them and discovered a swarm of eels tearing and stripping the flesh from the bones of a shad which had gilled itself near the cork line. Gathered in a writhing mass, with their heads centered upon the fragment of the fish, we had before us the living model of a drowning Medusa. There was at least a bushel of them, greedily crowding each other, fastening their teeth in the flesh of the shad, and by a quick, muscular torsion snatching pieces from the dying fish. It is not uncommon to see a dozen heads of shad, each with a long, slender backbone attached, taken one after the other out of the net, when a fisherman has delayed a little too long. Six good eels have been thrown into the boat by a dexterous jerk of the net where a mutilated shad was hanging. I have

seen four eels fall out of the abdominal cavity of a shad, when no eels were visible, when the fish came over the gunnel. They had devoured the viscera, which always seems to be the first portion sought by them.

"The habit is to run the net as soon as it is all out, and take the fish out immediately, before *they can be injured by the eels. The eels never mesh; they are too slippery to get entangled.* In the shoal fishing, when the weather becomes warm, the 'eel-cuts,' as these are called, often outnumber the marketable shad. The fishermen salt down the better ones for their winter food."

"The net is run twice or three times and is then taken up. Little else than shad is taken; a few striped bass and a few suckers are occasionally found. The captures, to each boat with two men, *number from 'water hauls' to several hundred shad.*

"After the first tide's fishing the boats anchor. Often several tie fast to another anchored one, and the men while away the hours to the next tide in gossip and yarn spinning, or go to sleep in the bottom of the boat. It often happens when anchored apart from the rest, they find themselves, in the small hours of the morning, chilly and solitary in the middle of the bay.

"*Quiet and harmony is the ordinary state of their communion,* although *the strife for good* berths sometimes arouses a dissension. An attempt to anticipate the line of boats in laying out the nets at too early a stage of the tide calls forth sudden and certain penalty. Not only the boats on each side, but some of those from a distance, crowd around and unite their protests, and when these are unavailing the offender is hemmed in by the boatmen, who, in a half jocose manner, yet with a fully in earnest purpose, set their nets across the line of direction he has started in 'surrounding him.' If he is still obstinate enough to persist or to attempt to cut the nets which are in his way, a melee ensues, and some sturdy boatman is apt to belabor him into reason with an oar, public opinion favoring a certain amount of this kind of punishment.

"The boats used in the head of the bay are small, and the mutton-leg sails have no provision for reefing. The foresail is much larger, and sail is shortened by unstepping the foremast and putting the mainsail in its place. At the approach of a squall they hurriedly pull in the nets and scatter like a shoal of mullets when a porpoise appears among them. They get caught out occasionally, and getting to the lee of the shoal or the island, they sometimes lie with the killock out all day."

FYKES AND POUND-NETS.—A large number of fykes are in use from Havre de Grace to Columbia in summer for the capture of perch, rock, and catfish. Under the Maryland law the use of pound-nets is prohibited, and their absence from the Susquehanna is a striking feature to one accustomed to seeing them in such general use in other parts of the bay.

STATISTICS.—**The history of the impoverishment of the Susquehanna fisheries is the same as for the Potomac.**

The minimum of production was reached in 1878, from which time there has been a gradual and steady increase.

The Susquehanna River.

	Number.	Value.
Men employed	1,643	.....
Nets	*3,342	$97,450
Boats	334	43,510
Products.		
Shad ..... pounds	2,119,000	96,705
Herring ..... do	3,483,333	62,700
Catfish ..... do	200,000	12,000
Perch and rock ..... do	60,000	6,000

*Four pounds; 36 haul-seines; 302 gill-nets; 3,000 fyke-nets.

7. MINOR TRIBUTARIES OF THE CHESAPEAKE BAY.

The minor tributaries, such as the Patuxent, Chester, Choptank, Wicomico, Patapsco, and the numerous creeks which indent the shores of the Chesapeake, contribute no insignificant portion of the total product of the Chesapeake area. We have not, however, the data enabling us to specify the exact amounts taken in each. Their aggregate is, however, included in the summaries for Maryland and Virginia, given in another section of this report.

4.—FISHERIES OF THE DELAWARE RIVER.

By MARSHALL McDONALD.

The present condition of the fisheries of Delaware Bay is discussed on a preceding page of this volume under the head of Fisheries of Southern Delaware.

The following is a statistical summary of the Delaware River fisheries in 1880, based upon general estimates:

Species.	Pounds.	Value.
Alewives	*a* 1,800,000	$26,000
Shad	1,050,000	82,500
Sturgeon	*a* 450,000	22,500
All other species	*b* 995,250	46,116
Total	4,295,250	147,116

a In addition, 596,700 pounds of alewives and 120,000 pounds of sturgeon were taken by the sea-fishermen.

b Includes 196,200 pounds of catfish, 150,000 pounds of perch, 100,000 pounds of striped bass, 15,300 pounds of turtle, and 533,750 pounds of mixed fish.

The following facts concerning the condition of the fisheries of Delaware River in 1837 are compiled from an article by Dr. Samuel Howell, in the American Journal of Science and Arts, Volume XXXII, 1837, page 134, entitled "Notice of the Shad and Shad Fisheries of the Delaware":

"The shad usually make their first appearance in the Delaware about the middle of March. In early seasons, however, they are occasionally taken in February.

"It is a singular fact that they are caught within a few days as early above the rapids, 160 miles from the ocean, as at the lowest fisheries on the river; but, although their advance guard would thus seem to move on with such celerity towards their place of destination, the main body evidently pursue their course more deliberately, and it is obvious from the operation of the successive fisheries that their progress upwards is slow, and that they do not move as fast as the tide would carry them, even admitting that they remain quiescent during the ebb. While they work their way slowly against the ebb-tide, it would seem that they head about and rather stem the upward drift of the flood. This is proved by the fact that the drift nets or gilling seines, which catch them meshed on their lower sides during their ebb drift, have them entangled on the opposite side when drifting upwards with the flood tide.

"While their general movement is upwards, for their final destination seems to be the clear shallow waters above the tide, their instinct instructs them to loiter by the way to employ their appropriate food, with which the turbid fresh waters of the river seem to abound; what this food is is conjectural.

"They certainly are not a fish of prey, and their alimentary canal on dissection discloses nothing but a greenish earthy slime, which is probably strained through their fringed throats as they suck in the water.

"We may fairly infer that their nutriment consists of the mucilage or matters held in solution by the waters. That they find congenial aliment in these waters is obvious from the fact that they increase in fat and flavor the longer they remain in the rivers.

"Whether all the myriads of shad which enter the Delaware annually would proceed to its head-waters if unobstructed is quite doubtful.

"There is some reason for believing that, like some of the migratory birds, they return annually to the parts of the river in which they were bred. How else are we to account for the marked difference observed in the shad taken in the different parts of the Delaware and its tributary streams? Those, for example, which are caught in the creek are so small and so inferior in flavor to those caught high up the river as almost to form a distinct variety of fish.

"The Trenton shad, or those caught at the falls, have from time immemorial been proverbial for their superiority in quality as well as size to those taken in the waters below.

"It would seem that these fish enter the Delaware in successive 'runs' or shoals, and the experience of all observant fishermen goes to prove that these runs make their appearance in ordinary seasons at definite periods. For example, there is a scattering run from the middle of March to the middle of April. These are for the most part small in size and not remarkable for flavor.

"From this period to the 25th of April occurs the great run, and this is felt at each successive fishery for nearly a week if no storm occurs to drive them into deep water, for it is a fact well ascertained that while in pleasant weather these fish swim near the surface, yet the moment a cold easterly wind commences blowing they sink so near the bottom that the deepest nets will sweep over their usual grounds in vain. This run generally continues until the beginning of May, after which period the successive shoals which enter the river are small and scattered until the termination of the season, which is usually about the 20th of June, though by an existing legislative restriction it [the fishing?] is limited to the 1st of that month in the lower waters of the river and to the 10th in the upper.

"The distinctness of these different runs is proved by the appearance of the fish, by their quality, and by the state of roe in the female, those of the late runs being for the most part less forward than those of the great run in April.

"The final cause of their annual visit is doubtless to seek a suitable place for the deposit of their eggs, which probably require a temperature higher than that of the ocean for their development, and a safe and appropriate nursery for their young during the early period of their existence, when they are of all others the most delicate.

"After having spawned the old fish soon disappear. They are occasionally caught, indeed, in the nets, but they are thin and worthless, and, from their attenuated condition, are called by the fishermen "racers."

"The young fish remain in the river until towards autumn, by which time they have attained the size of small herrings, when they in their turn disappear. They are caught in immense numbers in the weirs and racks and baskets which are constructed in the shallow waters above the falls for the purpose of taking the common river fish, and they are so tender as to be destroyed by the least violence. These contrivances, so destructive to the young fish, have consequently become objects of legislative prohibition.

"The destination of these fish after they quit the fresh water is unknown. I have never yet met with an authentic account of their being caught or even observed at sea, nor have naturalists attempted to trace their route through the ocean, as in the case of the herrings.

"Their term of life cannot be ascertained, but it is fair to infer that they attain their growth in a year, from the size to which the young attain during their short sojourn in our waters, as well as from the general uniformity of size observed in each of several runs.

"Their average weight may be about 7 pounds, but individuals are occasionally caught which weigh as high as 12 and even 13 pounds.

"The numbers of shad taken in the Delaware vary in different seasons. Perhaps it would not be far from the truth to estimate them at 30,000 at each shore fishery. Formerly, when fisheries were fewer, the number far exceeded this amount.

"I have no data by which to estimate the number caught by the gilling-seines, but from the rapid multiplication of these destructive contrivances it must be very great.

"The aggregate amount taken annually by the shore-seines and the drift-nets is probably not far short of 1,500,000, which, at $7 per 100, would be worth upwards of $100,000.

"The principal market is Philadelphia, but immense numbers are vended at the fisheries, to which people flock from all quarters in wagons and boats.

"The writer has known sixty and seventy wagons supplied in a day (each, perhaps, taking at least 100) at the Fancy Hill fisheries, 6 miles below Philadelphia. The great mass are salted like mackerel, and chiefly for domestic use. In the fresh state they are, in the height of their season, one of the most delicious of any of the finny race, and decidedly the best mode of cooking is that called 'planking,' which consists in nailing the fish to a clean oaken plank, previously heated, and setting it before a brisk fire. By this method the juices of the fish are all preserved.

"They are sometimes treated like hams, viz, by rubbing them with fine salt, saltpeter, and molasses, and smoked for a few days, and in this way are very superior to those cured with salt alone.

"The usual and most efficient method of taking the shad is by means of seines. [The description of the construction of the seine, the laying out, and hauling is similar to the methods now in use, and is not therefore reproduced.] The regular shore-nets vary in length from 150 to 500 fathoms. Formerly they were drawn in by manual labor alone. Of late years, however, capstans have been employed to aid in this laborious operation.

"The number of men required to manage a net varies from fifteen to twenty-five. The whole number employed at the Fancy Hill fisheries, including foremen, clerk, marketmen, tide-watchers, &c., is nearly one hundred.

"Besides the production of such an amount of healthful and delicious food in quantity generally sufficient to supply the States of Pennsylvania and New Jersey, the fisheries give profitable employment to a great number of men at a season when their services are not particularly required in agricultural labor.

"The fisheries therefore constitute an important interest to the States bordering on the river and one that merits the fostering care of their respective legislatures.

"The importance of this species of property was recognized at an early period of our history, when fisheries were comparatively few, and numerous salutary provisions were enacted from time to time in relation to them, whose object was to perpetuate their benefits and secure them to their rightful possessors.

"Amongst others were those protecting the fisheries from unnecessary interruption by vessels and rafts, which are expressly required to avoid the seines while fishing, and prohibited under severe penalties from anchoring within the fishing range of any of the fisheries.

"But of late years the legislatures of these States have been so occupied with political maneuvering and management, that they seem to have lost sight of many of the best interests

of their respective States, and amongst others of the fisheries. For while they are compelled to pay heavy taxes into the State treasury, in common with other real property, and are subjected to several onerous restrictions, which have been artfully imposed upon them upon the ground of preserving the breed of fish, they have been so far neglected by their legal guardians that the river has of late been virtually thrown open to common right, and a class of outlaws—men without a local habitation or a name—are now enjoying privileges and rights, without the shadow of benefit to the respective States, which laws and usages from time immemorial had secured to the riparian proprietor.

"I allude to the gill-net fishermen, who have literally taken forcible possession of the river Delaware under the plea of its being a common highway, and have virtually dispossessed the lawful owners of the fisheries of property which they considered as secure and as much their own as their farms.

"The several rights of fishery had been the fruitful source of litigation in this country from an early period of its history, but it had been so long recognized by legislative enactments and confirmed by the decisions of the highest judicial tribunals that the question seemed to be finally and incontrovertibly settled. This right, too, seemed to be effectually secured to the riparian proprietor, by the circumstance that it was necessary in order to its enjoyment that a foothold should be had on shore, whereon to manage the seine and secure its contents. This, of course, would subject any person who attempted to encroach on the fishing rights of another to an action of trespass, and consequently operated as an effectual protection.

"But the ingenuity of man, ever ready to evade restrictions that clash with his interest, has devised a mode of fishing by which all connection with the shore is rendered unnecessary, and which, although prohibited by statutory enactments, he is able to practice in utter disregard of law or authority. By this method the net is so constructed as to enlarge or to 'mesh,' as it is technically said, and not to inclose the shad, as is the case with the regular shore nets already described.

"The seine used by these freebooters is formed with meshes so large that fish are permitted to pass their heads through, and on attempting to retreat they become entangled by the gills.

"The twine, too, of which the nets are made, is so fine that it is not perceived by the fish until his head is in the toil and it is too late to escape. The nets are kept extended by means of a small boat at each end across the main channels, and thus extended they are permitted to drift for miles until they have become loaded, when they are taken into the boats, the fish secured, and they are again stretched off in the river as before.

"These contrivances are hence denominated drift-nets, or gilling-seines, and although prohibited by law, yet so lame are its provisions that it is morally impossible to enforce it, except in cases where the name of the offender can be obtained.

"These marauders, therefore, emboldened by the impunity with which they are enabled to carry on their predatory operations, have increased to such an extent as already greatly to depreciate the shore fisheries, and if not checked they must ere long render them worthless."

5.—THE FISHERIES OF THE HUDSON RIVER.

By MARSHALL McDONALD.

The sources of the Hudson are in the Adirondack Mountains. Its main tributary, the Mohawk, rises in the table-land which forms the divide between the waters that flow into Lake Ontario on the one side and into the Hudson River on the other, and flows southeast; but, breaking through the Catskills, precipitates itself at Cohoes to the level of the river valley of the Hudson by falls which are about 40 feet in height. These falls, while forming a magnificent water-power for the many factories along the river's banks present an insuperable barrier to the ascent of fish. An obstruction of this kind exists at Glens Falls, on the main river. Indeed, all the tributaries are characterized by similar impediments, and thus may explain the fact that the Hudson is not, and, as far as we can learn from historical data, has never been a salmon river, and yet, strange to say the Connecticut River, similar in physical features to the Hudson, in olden times had important and productive salmon fisheries.

The sturgeon fisheries of the Hudson were formerly of great importance, but now are of comparative insignificance. The shad fisheries have, however, maintained considerable importance, and in annual value are hardly inferior to those on the Albemarle, Potomac, or Susquehanna.

As explanatory of the decrease of certain fisheries on many rivers, it has been frequently alleged that the same is due to such deleterious influences as the disturbance of the waters by passing steamers, the pollution by sewage, and the refuse of the paper, calico, and other factories in operation along their banks. Were these valid reasons for the decrease of the river fisheries, then certainly would the fisheries of the Hudson be reduced to a minimum. Statistics, however, show that on this river, in spite of all these supposed baleful influences, the shad fisheries have fallen off less than in any other river on the Atlantic seaboard. It is manifest, then, that in accounting for the impaired shad fisheries of the Potomac and other rivers, we must adduce arguments more tenable than the disturbance and pollution of the waters. In New York Harbor alone, which is in an incessant state of turmoil, caused by the thousands of vessels daily plowing its waters, over 250,000 shad are annually taken.

The shad appear first in the lower bay, between Sandy Hook and Fort Washington, about March 20. They are taken at the Narrows, below Fort Washington, by gillers from Fort Lee, Hastings, and other points on the river. These men come down to meet the shad, and fish as long as their operations are profitable. The duration of the fishing season here is, however, very short, as the shad soon commence their upward movement. From Jersey City to Fort Lee fishing is carried on entirely by means of stake-nets. These are set in 40 to 60 feet of water. Such deep fishing necessitates very expensive preliminaries. The stakes or poles are cut from 60 to 80 feet long, and cost $7 to $10 apiece. They run out in long rows from the shore and are placed at intervals of 27 to 30 feet, often numbering thirty in a row. The nets are 5½-inch stretch mesh, and are made in squares of one hundred meshes. The nets are lashed to poles, which are fastened to the stakes by rings and ropes. In setting these nets it is necessary that the upper line should be 7 or 8 feet below the surface, so as to prevent being torn by passing vessels. If the fish are running deep the nets must be lowered on the poles, and *vice versa*.

The boats employed in fishing these stake-nets are superior to those usually found in attendance upon shad nets. They cost, according to Mr. John Ludlow, about $150 apiece. The fish are transported to the New York market by sloops and schooners, being vessels of from 12 to 18 tons burden, and costing from $700 to $1,000 apiece.

Between Fort Lee and Troy, as far as could be ascertained, drift-nets are exclusively used, with the exception of four haul-seines, one of which is operated at Troy, and three in the vicinity of Tivoli.

Shad are taken as high up the river as the dam at Troy, about 40 miles below Glens Falls. At that point, however, but few are captured at the present time. This dam is the only artificial obstruction on the river.

Sturgeon fishing on the Hudson is, at the present day, of very secondary importance, and the number of pounds taken annually would not materially increase the aggregate river production. No reliable data, however, were obtained, and therefore statistics of this fishery are not included in the summation for the river given below. The annual catch of sturgeon amounts probably to several hundred thousand pounds. The fish are used for local consumption, or are shipped to Albany and New York. When sturgeon fishing was of great importance on this river Albany was the chief mart, and hence the name "Albany beef." On the James River, Virginia, the meat of this fish is known as "Charles City bacon."

Undoubtedly large quantities of rock, or striped bass, perch, and other species are taken on this river in the summer and fall fisheries. No reliable figures were obtained, as the product of these irregular fisheries is always sent to New York and no accessible record kept of the quantities received.

Summation for Hudson River.

	Number.	Pounds.	Value.
Men employed	711		
Boats	328		$10,630
Vessels	6		4,800
Nets	1,516		*23,320
Products.			
Shad	639,000	2,556,000	142,040
Herring	225,000	75,000	2,250

*This includes cost of poles used in connection with the stake-net fisheries.

6.—THE CONNECTICUT AND HOUSATONIC RIVERS AND MINOR TRIBUTARIES OF LONG ISLAND SOUND.

By MARSHALL MCDONALD.

1. THE FISHERIES OF THE CONNECTICUT RIVER.

FORMER ABUNDANCE OF FISH.—The Connecticut River rises in Lake Connecticut, in the extreme northern part of New Hampshire, flows southward, forming the boundary line between that State and Vermont, crosses the entire States of Massachusetts and Connecticut, and empties into Long Island Sound. The tributaries of the Connecticut are small, flowing down from elevated regions. They are all natural trout streams, and those which have been preserved still afford good sport to the angler. In early days salmon were caught in these streams. In one, especially, the Farmington, which is an important tributary, shad and salmon were abundant, but

have disappeared since the erection of numerous dams along its course. At Bellow's Falls the Connecticut River descends about 60 feet by precipitous slopes. These falls, though effectually obstructing the further ascent of the shad, did not prevent the upward passage of the salmon, many of which ascended above this point to suitable spawning ground. An interesting account of these early fisheries is given in Judd's History of Hadley, Mass., which is here reproduced:

"When the English established themselves on the banks of the Connecticut there was in the river and tributary streams, in the proper seasons, a great abundance of shad, salmon, bass, and other fish, such as the Indians had long used for food. The shad, which were very numerous, were despised and rejected by a large portion of the English for near one hundred years in the old towns of Connecticut, and for about seventy-five years in those Hampshire towns above the falls. It was discreditable for those who had a competency to eat shad; and it was disreputable to be destitute of salt pork, and the eating of shad implies a deficiency of pork. The story which has been handed down that in former days the fishermen took the salmon from the net and often restored the shad to the stream is not a fable. Poor families ate shad, and doubtless some that were not poor, and they were sometimes put in barrels for exportation. Connecticut shad in barrels were advertised in Boston in 1736. The first purchase of shad found in any account book in those towns was made by Joseph Hawley, of Northampton, in 1733; he gave for thirty shad 1 penny each, which was not equal to half a penny in lawful money. Ebenezer Hunt gave 1½ pence for shad in 1736, 2 pence for 'good fat shad' in 1737, and 2 and 3 pence in 1742 and 1743. Ebenezer Hunt bought bass, suckers, pickerels, and common eels. No trout are mentioned. He says of shad in 1743, 'shad are very good, whether one has pork or not.' These prices were all less than a penny in lawful money.

"The early settlers of Pelham bought many shad. After the specie currency in 1750 shad were usually 1 penny each. Josiah Pierce, of Hadley, bought one hundred shad at a penny each in 1762, ninety shad at a penny in 1763, and shad at a penny in 1764, 1765, and 1766. Oliver Smith, of Hadley, gave a penny each for thirty shad in 1767. For forty years after 1733 the price did not exceed a lawful penny. From 1773 to 1776 the price was 2 coppers each, or 1⅓ pence; from 1781 to 1784, from 2 to 3 coppers; in 1788, 2½ and 3 pence; in 1796, 3½ and 4 pence; and in 1797 and 1800, 4 pence half penny. The dams across the river and other impediments diminished the number of shad, and they gradually advanced in value to 6 pence, 9 pence, 1 shilling, and higher prices, and men ceased to buy shad to barrel for family use.

"Field's account of the county of Middlesex, Conn., 1819 (Middletown, Haddam, &c.), says there was such prejudice against shad and some other fish, because they were so generally used by the Indians, or from some other cause, that little effort was made to take them for more than a century after the county was settled. Within the memory of persons living (1863) there was very little demand for salmon, and as for shad it was disreputable to eat them. A story is told in Hadley of a family in that place who were about to dine on shad when it was not reputable to eat them, hearing a knock at the door, the platter of shad was immediately hid under a bed. There is a minute in John Pynchon's account book which shows that shad were not slighted by all those who were in good circumstances in the seventeenth century. In 1683 he sold a fish-net and agreed to receive for pay some shad packed for market, and 'fifty shad for my family spending at times.'

"Shad-eating became reputable thirty years before the Revolution. Shad were caught plentifully in many places in Connecticut before 1760, and were sold at 1 penny and 1½ pence each some years later. They were carried away on horses. Some thousands of barrels of shad were put up in Connecticut for the troops from 1778 to 1781. Shad never ascended Bellows Falls at Walpole, nor

could they ascend the falls of Chicopee River. Salmon passed up both. In 1739 Brookfield petitioned the general court for liberty to make a passage for shad through the bars of rocks across Chickopee River in Springfield, so that they might come up the river into the ponds. Springfield opposed, and liberty was not granted.

"Salmon were used, but were seldom noticed in records in the seventeenth century. Salmon-nets began to appear before 1700, and some salmon were salted in casks by families before and after 1700. They were seldom sold, and the price in Hartford, in 1700, was less than 1 penny per pound. Fish were so plenty in the Connecticut and its branches that laws were not necessary to regulate fishing for a long time. There was a law in Massachusetts against erecting wears or fish-dams in rivers without permission from the court of sessions. Petitions for liberty to erect wears to catch fish in the Hampshire streams began in 1729, and there were several after 1760. These wears were chiefly for the purpose of catching salmon. In Northampton salmon were sold from 1730 to 1740 at a price equal to 1 penny per pound, in lawful money, and some at 1⅓ pence. The price in 1742 was 1½ pence, and from 1750 to 1775 it was commonly 2 pence per pound. Josiah Pierce, of Hadley, bought salmon from 1762 to 1765 at 2 pence, and some at 1*s.* 6*d.*, old tenor, or 2⅔ pence. He bought some years about 70 pounds of salmon. Oliver Smith bought 27 pounds of salmon in 1773 at 2 pence, and Enos Smith 57 pounds in 1776 at 2⅓ pence. The price was from 2 to 3 pence from 1781 to 1787, 4 pence in 1794, and it advanced to 7 or 8 pence in 1798. The first dam at South Hadley, about 1795, impeded the salmon, and the dam at Montague was a much greater obstruction, and salmon soon ceased to ascend the river. Few were caught after 1800. Some of the prices of shad and salmon noted were retail barter prices.

"There were at least three [fishing places] in Hadley. One was below the mouth of Mill River, on Forty Acre Meadow. A more important one was a little east of the lower end of the street, where the river flowed near the street. There was another in Hockanum Meadows. Opposite to the two last, Northampton men had fishing places. (The Northampton and Hadley men were often near each other, and they bantered and joked abundantly, and sometimes played tricks and encroached upon each other. These things proceeded not from ill-nature, but from love of fun.)

"The late Elihu Warner remembered when forty salmon were caught in a day, near the lower end of the street, about 1773, the largest of which weighed between 30 and 40 pounds. (Mr. Pierce and six others owned a seine in Hadley in 1766. The whole income of the seine for the fish season was £22 17*s.*, and the expenses were £14 12*s.* 10*d.*, leaving for gain £8 4*s.* 2*d.* Shad were then 1 penny each.)

"In South Hadley there was a noted fishing place near the mouth of Stony Brook, and another above Bachelor's Brook against Cook's Hill. Many salmon were taken at those places; 24 are said to have been caught at one haul near Stony Brook, weighing from 6 or 8 to 40 pounds. There were other fishing places in South Hadley above the falls.

"The falls of rivers were great fishing places in New England for the Indians and the English. The falls at South Hadley, called Patucket by the Indians, were one of the most favorable places on the Connecticut for taking fish. Though there is no intimation in any old writing that the Indians resorted to that place for fishing, and very little is found recorded which indicates that the English frequented it for that purpose before 1740, yet it cannot be doubted that the Indians caught fish there in early days and the English before 1700. (In 1685, when Northampton and Springfield settled the line between them, west of the river, it was agreed that Northampton might catch fish at the lower falls, below the line. The fishery was then thought to be of some importance.)

"The following account of the fishery at the falls, after the Revolution, was derived from two aged men in 1848, Joseph Ely, in his ninety-second year, and Justin Alvord, in his eighty-fifth year, who had often caught fish at the falls, and from others since 1848:

"Fishing generally began between April 15 and May 1, very seldom as early as April 15. The best fishing season was in May. Shad were caught in seines below the falls, and in scoop-nets on the falls. Boats were drawn to places on the rocky falls, fastened, and filled with shad by scoop-nets, then taken ashore, emptied and returned. A man in this manner could take from 2,000 to 3,000 shad in a day, and sometimes more with the aid of a boatman. These movements required men of some dexterity. There were some large hauls of fish at the wharves below the falls. The greatest haul known was 3,500, according to Ely, and 3,300, according to Alvord. (One man, of South Hadley, gives 3,000 as the largest haul. Connecticut archives contain an account of 3,000 shad taken at a haul in the cove at East Haddam before 1766. The number in these great hauls is probably exaggerated.) It was not often that 1,500 or even 1,200 shad were taken by one sweep of the net. (Morse's Geography, fifth edition, says there were as many as fourteen fishing wharves at the foot of the falls in 1801, and that they sometimes caught 1,200 fish at one haul; it was reported that one company cleared $4,800 in one season.)

"Salmon were taken on the falls in dip-nets, and below, in seines, with shad. Before their day salmon had been taken at the foot of the falls, in places called pens. Ely had never known a salmon taken at the falls that weighed over 30 pounds; some weighed 20, and many from 6 to 10 pounds. They were always few in number compared with shad. The river seemed to be full of shad at times in some places, and in crossing it the oars often struck shad. Ely and Alvord, like other old men, related that fishermen formerly took salmon from the net and let the shad go into the river again, but not in their time, and that people in former days were ashamed to have it known that they ate shad, owing, in part, to the disgrace of being without pork. Alvord sold thousands of shad after the Revolution for 3 coppers each, and salmon were sold from 2 to 3 pence per pound. It was much more difficult to sell salmon than shad. Some bass were caught with hooks after shad time. Sturgeon were taken at the falls with spears. Lampreys, called lamprey-eels, had long been plenty on the falls, and many were taken at night by hand by the aid of torch-lights. Some were eaten in a few towns in Old Hampshire, but most were carried to Granby, Simsbury, and other towns in Connecticut. (Lampreys came above the falls in great numbers, and entered the streams that run into the Connecticut, until the Holyoke dam was built in 1849. They were very numerous in Fort River, in Hadley, below Smith's Mills, and were caught by the light of torches, sometimes several hundred in a night. Men waded into the streams and grasped them with a mittened hand and placed them in a bag. Sometimes the lampreys in the night crawled into and about the flutter-wheel of the mill and into the throat of the gate in such great numbers that the wheel could not be turned in the morning until they were cleared away. In Northampton Mill River, below the lower mills, lampreys were caught in the same manner as in Hadley, and in other ways. In a dark night men might be seen in the river, clasping now and then with one hand a squirming lamprey, and holding in the other a birch-bark torch, which threw light on the river and on all objects on its borders. Very few were cooked in Northampton and Hadley; many were given to hogs. Some were conveyed to other towns in Massachusetts, but most to Connecticut. None are now caught above Holyoke dam.)

"Shad seasons brought to the falls, on both sides of the river, multitudes of people from various quarters. Some came from Berkshire County. All came on horses with bags to carry shad, except a very few who had carts. Some, intending to purchase two loads of shad, led a horse. For

some years there were only two licensed inn-keepers at the falls—Daniel Lamb and widow Mary Pomeroy, but every house on both sides of the river was full of men, and some lodged in shelters and out-houses. Horses filled the stables and many other places. It was estimated one day that there were 1,500 horses on both sides of the river; this estimate is not reliable. A great number of the men brought victuals with them; many cooked shad, and others bought food at the houses. Many were detained one day or longer. They indulged in plays and trials of skill. Where there were so many men, and rum was plenty, there was of course much noise, bustle, and confusion. The greater part were industrious farmers, and after leaving the falls they wound over the hills and plains with bags of shad, in every direction. They were plainly dressed, according to their business. There was another class at these gatherings, composed of the idle, the intemperate, and the dissipated. They came to drink and frolic, and some to buy shad if their money held out. (There were great gatherings at Amoskeag Falls, on the Merrimac, in the fishing season, more than a century since. In 1742 Rev. Joseph Lecombe gave them a discourse, which was published. Judging from the title, it must have suited the merry-makers). Many thousands of shad are still taken annually at South Hadley Falls, though none can ascend the river above Holyoke dam. Instead of a penny each, which was paid one hundred years ago, men now pay at retail for shad brought from these falls and from Saybrook from 25 to 40 cents, and sometimes 50 cents."*

THE CHICOPEE RIVER.—The Chicopee, though one of the principal tributaries of the Connecticut, reaches the level of that river by falls, which have always proved an insurmountable barrier to the ascent of fish, and has never, therefore, been a salmon stream.

EFFORTS TO INCREASE THE SUPPLY.—The fisheries of the Connecticut have always been important, although the annual production is steadily diminishing, owing to the restrictions alluded to and the consequently impaired spawning-grounds. The shad, salmon, and alewife have been the species most eagerly sought after. The salmon-fishery is now practically extinct. New Hampshire, Massachusetts, and perhaps Connecticut, have, however, co-operated in their efforts to restore this fishery by planting salmon fry in the sources of the river. As a result of these experiments, some salmon have now returned to the river, and specimens have been taken in gill-nets at the mouth, at the first obstruction on the Farmington River, and at Holyoke Dam, near Hadley Falls, on the main river. It is not probable that such measures will result in any permanent restoration, since no suitable spawning-grounds are accessible to these fish upon their return from the sea. It was hoped that the very costly fishway erected over the dam at Hadley Falls would open a passageway for both shad and salmon into the Upper Connecticut, and in this way provide for the permanent restoration of the salmon-fishery under natural conditions. There is no evidence, however, that such results have been brought about. Certainly no shad have ascended it, and no salmon, if their capture above that point is to serve as a criterion. This dam being the only obstruction of consequence, it would appear that the importance of the result to be looked for would justify the States interested in the fisheries of this river in making a large expenditure of money in order to secure an open river.

At the present time the alewife-fisheries are insignificant, although their numbers seem to have been increasing since the enactment of a law prohibiting the placing of pound-nets in the river and fixing the minimum size for the mesh of haul-seines; the number of haul-seines fished has been greatly diminished by the restrictions imposed.

*History of Hadley, Mass., by Sylvester Judd, pp. 313 to 318.

THE SHAD-FISHERY.—The shad-fisheries of the Connecticut are still of great importance, though the number annually captured on this river by no means equals that taken on any of the other principal rivers of the Atlantic coast, from which latter, however, we would expect no larger yield than from the Connecticut River.

The following tables, from the report for 1870 of the Connecticut commissioners, giving statistics showing the annual catch of the fishery for a series of years at Griswold's Pier, at Lyme, and of the fishery formerly known as the Parsonage Pier, are interesting, as they show the material diminution which has gradually taken place at these fisheries.

Griswold's Pier, Lyme.

Year.	Number of shad.	Year.	Number of shad.	Year.	Number of shad.	Year.	Number of shad.
1845	10,043	1855	10,125	1860	1,470	1865	3,974
1846	7,850	1856	10,200	1861	6,000	1866	4,445
1847	6,540	1857	3,357	1862	7,000	1867	1,730
1851	10,246	1858	11,646	1863	5,000	1868	830
1854	8,500	1859	10,200	1864	1,943	1869	1,500

The books of this pier are lost from 1847 to 1851; also from 1851 to 1854.

For one or two years previous to 1845 the average catch was 12,000 per year.

Mr. Griswold writes that for the last three years he lost money, and was obliged to abandon this fishery.

Fishery known as the Parsonage Pier.

Year.	Number of shad.	Year.	Number of shad.	Year.	Number of shad.	Year.	Number of shad.
1827	3,091	1838	8,734	1849	19,410	1860	2,045
1828	10,716	1839	9,029	1850	20,401	1861	19,654
1829	7,138	1840	7,230	1851	25,227	1862	6,440
1830	3,917	1841	8,727	1852	14,257	1863	5,675
1831	9,064	1842	7,230	1853	18,138	1864	5,491
1832	11,713	1843	3,415	1854	10,148	1865	10,672
1833	8,070	1844	11,038	1855	8,230	1866	2,100
1834	14,934	1845	16,091	1856	13,940	1867	4,864
1835	23,376	1846	12,798	1857	8,826	1868	1,970
1836	11,050	1847	18,600	1858	9,826	1869	1,796
1837	9,096	1848	13,408	1859	7,846		

No account of the number of shad taken in the pounds is given, as no satisfactory information concerning them could be obtained. It is reported that on the 14th of May, 1870, the pounds yielded from 300 to 1,100 shad each, which is probably above the average.

In this connection also the following statement by R. B. Chalker, of Saybrook, Conn., regarding the yearly catch of a pound-net, located 4½ miles west of the mouth of the Connecticut River, in the town of Westbrook, Conn., furnishes additional information of the same tenor:

Catch of a pound-net at mouth of Connecticut River.

Year.	Number of shad.	Remarks.
1856	3,643	The location of the pound was not changed during the period for which the records are given.
1857	5,183	
1858	6,111	
1859	3,000	
1860	6,000	
1861	6,180	
1862	6,853	
1863	10,730	
1864	12,265	
1865	9,410	
1866	10,594	
1867	12,500	
1868	13,000	
1869	11,000	
1870	16,558	
1871	13,508	
1872	8,271	Laws permitted fishing but three days in each week.
1873	7,343	
1874	9,290	
1875	20,037	
1876	11,041	
1877	10,465	
1878	4,550	1878. Nets destroyed by jelly fish. A good run of shad, but impossible to continue pound fishing after the 5th of May, for the reason stated.
1879	19,175	
1880	17,275	

Aggregate catch for the ten years from 1856 to 1865, inclusive	69,375
Average catch per season	6,937
Aggregate catch for the ten years from 1866 to 1875, inclusive	122,101
Average catch per season	12,210
Aggregate catch for the five years from 1876 to 1880	58,506
Average catch per season	11,701

The above table shows the average increase of catch in pound-nets since their introduction in place of hauling seines. The first pound-net set for shad in Westbrook was in the year 1849.

In the early shad fisheries of the Connecticut River haul-seines were mainly employed. This mode of fishing involved a considerable outlay of capital for their equipment and operation. Gradually gill-nets supplanted haul-seines, and, on account of the unproductiveness of the latter, came into more general use. These again were supplanted to a great extent by the introduction of pound-nets, which, as the law prohibited their being set in the river itself, occupied every available position along the shores of the sound from the mouth of the river to a distance of some 6 or 8 miles west. Practically, however, these nets are in the river itself, being so placed as to intercept the run of the shad. It is curious to note that these pound-nets are exclusively set on the west side of the mouth of the river; and in response to inquiry as to why this was so, the information was given that shad could not be taken in any large numbers on the east side of the river's mouth. This would indicate that the shad run up the shore line from west to east, which conclusion has led to the inferences that the fish enter Long Island Sound at its extreme western end, and also that the shad of the Connecticut, the Hudson, and, of course, of the minor streams lying between these two rivers, are detachments of the same schools of fish.

THE ALEWIFE FISHERY.—The alewife fisheries are insignificant, and are operated only in several coves along the river's banks, the law prohibiting nets from being fished in the main stream. Conspicuous among these fisheries is that conducted at Weathersfield Cove, by Mr.

Winthrop Buck, by whom a small haul-seine is employed. The following statistics of the fishery at this point will be interesting, as they serve to show the extent of equipment necessary to make the operation profitable. The seine (nine-thread) is 75 fathoms long, and is hauled by windlass. The crew consists of four men. About one-twentieth of the fish taken are consumed fresh, the remainder being salted, and packed in barrels, each capable of holding five hundred fish, and shipped to New York. The highest point at which alewives are taken on this river is at Windsor Locks, and all these fisheries lie between there and Middletown. The season commences about the second week in April. In 1880, however, it was earlier than usual, the run beginning in the last week of March.

STATISTICS OF CONNECTICUT RIVER FISHERIES IN 1880.—The following statistics of the fisheries of the Connecticut River for 1880 have been prepared by Mr. R. B. Chalker, of Saybrook, who is extensively engaged not only in fishing but also in buying and marketing the product of the river, and who is therefore eminently fitted to give exact data on this subject:

	Nets.		Number of men.	Boats.		Value of shore property.	Product.			
							Shad.		Alewives.	
	Number.	Value.		Number.	Value.		Pounds.	Value.	Barrels.	Value.
Gill-net fishery	57	$4,275	114	57	$1,275	.....	225,980	$11,299 00	.....	.....
Haul-seine fishery	24	6,450	137	61	2,344	$1,305	176,224	8,811 20	2,700	$10,800
Pound-net fishery	30	29,732	75	30	4,500	1,500	703,136	35,156 80	.....	.....
	111	40,457	326	148	11,119	2,805	1,105,340	55,267 00	2,700	10,800

The larger proportion of the shad product of the Connecticut River is sent to packers in Lyme, Essex, and Saybrook. Thence they are shipped in ice to various points, but chiefly to New York City. There are 10,420,000 pounds of menhaden taken in the pounds. These are composted for conversion into manure.

From the statistical returns made by the pound-net fishermen, in response to a circular issued by the U. S. Fish Commission, has been selected that of Mr. S. A. Chalker, who operated a single pound at Cornfield Point, in Long Island Sound, and 5 miles west of the mouth of the Connecticut. These figures represent a fair average of the necessary pound-net equipment, of the product of the fishery, and of the cost of operating the same during one season.

	Number.	Pounds.	Value.
Men employed	3	.....	.....
Pound-nets	1	.....	$400 00
Boats	2	.....	75 00
Capital invested	.....	.....	497 00
Product.			
Shad:			
Sold fresh on beach	.....	632	37 92
Shipped in ice	.....	22,936	1,376 16
Salted	.....	360	21 60

2. THE HOUSATONIC RIVER.

Formerly valuable fisheries for the capture of both shad and salmon were operated on this river. Those for the latter, however, no longer exist, the species having been exterminated by the erection of dams, and the upward movement of shad is now limited to a reach of about 30

miles of water extending from the mouth of the river to the dam at Derby. Within these limits 11 haul-seines are fished. The following statistics show the extent of the fisheries of this river in 1880:

Haul-seines:	
Number	11
Value	$1,650
Number of men employed	47
Boats:	
Number	11
Value	$220
PRODUCTS.	
Shad:	
Pounds	28,600
Value	$1,430
Miscellaneous fish:	
Pounds	165,000
Value	$6,600

3. MINOR TRIBUTARIES OF LONG ISLAND SOUND.

While some shad and a considerable number of alewives are taken in all these streams, it is not possible to present accurate statistics of the catch for each. In the general summary of the fisheries of Massachusetts and Long Island Sound, however, are included these figures, those for Massachussetts being included in the statistics of the Massachusetts fisheries given by Mr. A. Howard Clark in another section of this report.

7.—THE RIVERS OF MASSACHUSETTS* AND NEW HAMPSHIRE.

1. THE TAUNTON AND COLE'S RIVERS.

By W. A. Wilcox.

The shad and alewife fisheries of the Taunton River are carried on by 108 men, who use 29 boats, 15 seines, and 1 weir, worth, with their fixtures, about $7,500. The catch in 1879 was 1,718,000 alewives, equal to about 4,000 barrels, and 6,615 shad, weighing 21,498 pounds. The value of these products was $12,090. A portion of the alewives were sold fresh, the rest pickled or smoked. The shad were sold fresh in Boston and other markets.

In Cole's River, in the town of Swansea, 4 miles west of Fall River, at the northern end of Mount Hope Bay, there is a small fishing station. The northern and northwestern ends of the bay are valuable for their scallop and clam beds, which extend from Kickamuit River on the west to Taunton River on the east, a distance of 5 miles.

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* In the Connecticut River at Hadley, Mass., discussed in the preceding chapter, there are annually captured about 3,500 shad. The total catch of pound-nets, seines, and gill-nets set in the Taunton, Merrimac, and other rivers, and along the shores of the State, during the year 1882 is reported by the State Commissioners of Inland Fisheries to have been as follows (in numbers): Shad, 44,734; sea herring, 1,512,660; alewives, 4,446,280; menhaden, 8,735; mackerel, 3,876,599; Spanish mackerel, 307; bluefish, 325,473; striped bass, 5,929; scup, 2,090,526; squeteague, 71,471; tautog, 46,757; flounders and flatfish, 148,330; eels, 7,049.

In the Mystic River, near Boston, in the Chebacco and Essex Rivers, and in some other streams of the State, alewives were formerly taken in abundance, but these fisheries are now of very little importance.

Eels are plenty in this river, and are taken in a conical basket-work trap, 2 feet long. The catch is sent to New York. A few fyke-nets are used in the winter, and the catch of flounders is used at and near home.

The fisheries of Cole's River in 1879 gave employment to 19 men. The capital, invested in 6 small sail-boats, 40 scallop dredges, and 100 dories, amounted to $960. The products, worth $5,332, included 19,200 pounds of eels, and 3,000 pounds of flounders.

2. BUZZARD'S BAY AND ITS TRIBUTARIES.

By W. A. Wilcox.

The Acushnet, Mattapoisett, and Wareham Rivers, and the minor tributaries of Buzzard's Bay, have always abounded in alewives, eels, and other river species, while the bay itself has been an important fishing ground for menhaden, tautog, oysters, and scallops. About thirty pound-nets are set at various points near the head of the bay. They are worth from $400 to $500 each, their principal catch being menhaden, alewives, tautog, scup, squeteague, bluefish, and eels. A number of unregistered sail-boats, owned at Fairhaven and New Bedford, fish from June 1 to November 1 with hand-lines in the Acushnet River and in the bay, their catch being chiefly tautog, eels, and scup. The oyster and scallop fisheries are discussed in another chapter.

The Acushnet River.—This river is really an arm of Buzzard's Bay for the three miles from its mouth along the Fairhaven and New Bedford fronts. Above New Bedford it decreases in size to a small stream, no larger than a brook, and takes its rise near the south shores of Long Pond and Aquitticaset Pond, in the town of Middleborough, 10 miles distant. There are several islands in the stream; the largest is named Palmer, and is at the entrance to the harbor. The next to the north are Crow, Pope's, and Fish. This last is united to the long draw-bridge connecting Fairhaven and New Bedford. Several other smaller islands, not named, add to the beauty of the river scenery.

Although the bay and river have always been noted as having an abundance and great variety of scale and shell fish, and the flats and near shores for miles have long been known to abound with quahaugs and clams, until lately there appears to have been but little attention paid to them, except in a small way for home use. Within the past twenty years, as the whale fishery has declined, more attention has been paid to the abundance of fish near home.

Eels are abundant in the Acushnet, and are mostly caught in a box-trap of simple and cheap construction. This is four feet long, 10 inches wide, with slatted sides. There is a hole in each end 4 inches square. In the aperture are placed two small wooden slats. The eels slide in with ease, the slats opening as they glide in and immediately closing. The box is weighted with stones and baited with clams. At Sconticut Neck within late years the business has steadily grown, the catch being made with gill-nets, purse and shore seines.

The Mattapoisett River.—Alewives are taken in the Mattapoisett River. One weir is located 4 miles from the river's mouth, and two more at Rochester, 4 miles beyond. For the past 10 years the catch has averaged 900 barrels a year. The catch of 1880, the smallest for twenty years, was 500 barrels, taken at the lower station, and 200 at the upper. The greater portion of them are sold fresh through the neighboring towns. A local law fixes the price for a limited supply to the citizens of Mattapoisett, Marion, and Rochester, at 25 cents for a hundred fish. At the northeast entrance to the harbor, on Pine Island, are two weirs. These are fished by four men for six months in the year. At the fishing stations of Mattapoisett, Pine Island, and

Rochester, in 1880, eleven men were employed for a part of the year. The capital invested in apparatus was $2,130. The catch, valued at $2,275, included 1,000 barrels of alewives and menhaden, 2,000 lobsters, 1,000 squeteague, 8,000 tautog, 9,000 scup, 500 bluefish, and 25 Spanish mackerel.

WAREHAM AND HALF-WAY-POND RIVERS.—At Agawam station, in East Wareham, 3 miles inland from the northern end of Buzzard's Bay, is Half-way-pond River. This empties into the Wareham River, and the latter into the bay. Large bodies of alewives annually pass from the bay up these rivers to spawn, a considerable number being taken at East Wareham. The State law determines the time when they may be taken; this period is between April 1 and June 1. The exact time when they may be caught, the price at which they may be sold to citizens, and other regulations are left to a committee of three from each of the towns of Wareham and Plymouth. This committee sells the exclusive privilege of the catch at auction, and $400 to $500 a season is generally realized by the sale. The price which the citizens must pay is fixed by the committee at 16 cents a hundred fish, or 64 cents a barrel; one barrel is allowed to each inhabitant who may desire it. No fish may be sold to any except citizens for the space of two hours after the fish are caught, but after that time they may be sold to any person at such price as can be agreed upon. Provision is made that citizens shall always be able to obtain a limited supply at the price already mentioned, namely, 16 cents a hundred. The bulk of the catch is sold by peddlers through the neighboring towns. At the present time the catch is not more than two-thirds as large as it was a number of years ago. In 1880 the fisheries of this place gave employment to six men for 2 months. The catch was 700 barrels of alewives, worth $1,050.

THE ALEWIFE FISHERIES OF WAREHAM IN 1815.—The following statement of the condition of the alewife fisheries of Wareham, Plymouth County, Massachusetts, in 1815, is quoted from the Collections of the Massachusetts Historical Society, Vol. IV, 2d series:

"Of the alewife, there are evidently two kinds, not only in size but habit, which annually visit the brooks passing to the sea at Wareham. The larger, which set in some days earlier, invariably seek the Weweantic sources. These, it is said, are preferred for the present use, perhaps because they are earliest. The second, less in size, and usually called 'black backs,' equally true to instinct, as invariably seek the Agawaam. These are generally barrelled for exportation. In the sea, at the outlet of these streams, not far asunder, these fish must for weeks swim in common, yet each selects its own and peculiar stream. Hence an opinion prevails on the spot that these fish seek the particular lake where they were spawned.

"Another popular anecdote is as follows: Alewives had ceased to visit a pond in Weymouth, which they had formerly frequented. The municipal authorities took the usual measures, by opening the sluice-ways in the spring at mill-dams, and also procured live alewives from other ponds, placing them in this, where they spawned and sought the sea. No alewives, however, appeared here until the third year; hence three years has been assumed by some as the period of growth of this fish.

"The popular opinions at either place may or may not agree with the laws of the natural history of migratory fish. The young alewives we have noticed to descend about the 20th of June and before, continuing so to do some time, when they are about 2 inches long, their full growth being from 12 to 15 inches. We have imbibed an opinion that this fish attains its size in a year; but if asked for proof, we cannot produce it. These fish, it is said, do not visit our brooks in such numbers as in former days. The complaint is of old date. Thus, in 1753, Douglass remarks on migratory fishes: 'The people living upon the banks of Merrimack observe that several species of fish, such as salmon, shad, and alewives, are not so plenty in their seasons as formerly; perhaps from disturbance, or some other disgust, as it happens with herrings in the several friths

of Scotland.' Again, speaking of herrings, he says: 'They seem to be variable or whimsical as to their ground.' It is a fact, too, that where they most abound, on the coast of Norway and Sweden their occasional disappearance is a subject of remark, also of early date, in a comparative view. 'Previous to the year 1752 the herrings had entirely disappeared seventy-two years on the coast of Sweden; and yet, in 1782, 139,000 barrels were cured by salt at the mouth of the Gothela, near Gottenburg.'—*Studies of Nature.*

"The herring is essentially different from the alewife in size (much smaller) and in habit. It continues, we believe, in the open sea, and does not seek pond heads. Attempts are sometimes made, by artificial cuts, to induce them to visit ponds which had not before a natural outlet. These little cuts, flowing in the morning become intermittent at noon, as the spring and summer advances. Evaporation, therefore, which is very great from the surface of the pond should probably be considered in the experiment, making the canal as low as the midsummer level of the pond, otherwise it may be that the fish perish in the passage. This may, in other respects, have its inconveniences at seasons when the ponds are full.

"The town of Plymouth for a series of years annually voted from *1,000* to *500* and *200* barrels of alewives to be taken at all their brooks in former years.

"In the year 1730 the inhabitants were ordered not to take more than 4 barrels each; a large individual supply, indeed, compared with the present period (1815), when it is difficult for an householder to obtain 200 alewives, seldom so many.

"In 1762, at a vendue, the surplus appears to have been sold in 25-barrel lots, which sold at 3*s.* 7*d.* and 4*s.* the barrel. In 1763 Plymouth and Wareham took 150 barrels at the Agawaam brook.* Two hundred barrels was the usual vote, down to a modern date, perhaps 1776. Menhaden were also taken in quantity at Wareham, and barrelled for exportation in former years. Agawaam appears to have been a name for several places where migratory fishes resorted. Thus at Ipswich and Westfield River as well as this place. Wood, in his 'New England Prospect,' writes the word Igowam. At the season of fishing the whole population of the country was, doubtless, in motion, resorting to these places. Hence we incline to the opinion that this expression became in several places a fixed and permanent name, and was in some way typical of it. We think 'abundance of food' is understood."

3.—THE ALEWIFE FISHERY OF CAPE COD.

By Frederick W. True.

The alewife streams.—The alewife fishery has been prosecuted by the people of Southeastern Massachusetts from the earliest colonnial days. The regularity with which the alewives visited the coast, and the abundance of the supply, soon caused them to rely upon the products of the fishery for sustenance to a considerable degree, especially in those years when other fisheries suffered decline. The statute-books of the Commonwealth contain many laws and regulations relating to the alewife fishery, whose object is its extension or preservation.

The fishery proper consists in the capture of alewives while ascending the streams to spawn, but large quantities are also taken in the weirs and pounds which are in use at many points along the coast, and likewise in gill-nets and seines.

The interior and higher portions of the territory of Cape Cod and Martha's Vineyard are dotted with numerous fresh-water ponds, from which small streams run down to the sea. In

* Plymouth retains a fishing privilege in this brook within Wareham. The alewives, we are told, were more numerous in 1815 than for some years.

spring large schools of alewives run up these streams and pass into the ponds above to spawn, and it is at this time that the fishery takes place. The fish are taken either while passing up the stream, or while in the pond, but the former is the more usual method. When it is observed that the schools are in motion a piece of fine-mesh net is stretched across the stream, which in many instances is not more than 2 or 3 feet wide, and when a sufficient number of alewives have crowded against it dip-nets are brought into use and the fish are transferred to barrels or other receptacles. On the banks of some of the more profitable streams small fish-houses have been erected, and the portion of the bed of the stream adjacent encased in boards, forming a narrow sluice-way.

In the rivers whose width may be many rods, the fishery is prosecuted by means of seines, strongly made, and having rather fine meshes. These are hauled at certain hours, day by day, until the schools cease to come, or the supply obtained is sufficient. The amount taken by these means is, of course, greater than that obtained in the small streams.

It sometimes occurs that the stream, instead of flowing from a single pond, issues from a chain of ponds lying near each other, and closely connected. Occasionally the number is only two, as, for example, at the head of Bass River; but sometimes it swells to seven or eight, as is the case at the head of the Wellfleet alewife stream. Under these circumstances it is usual to fish in one of the lower ponds rather than in the stream itself. This is done notably at Bass River, where the fishery is prosecuted in the second or lower pond. The method here employed is naturally that of seining. The seines used vary in length and depth according to the dimensions of the ponds. Those employed in Bass River are 100 or 175 yards long, with meshes 2 inches in diameter.

LAWS AND REGULATIONS.—The laws and limitations by which the fishery in the numerous public streams is regulated, vary somewhat in different towns. One rule, however, apparently holds good for all, namely, that the citizens of the town through which any given alewife stream flows shall have the privilege of obtaining a certain quantity of fish gratis, or at a nominal price. The arrangements at Sandwich, which may be regarded as typical of those affecting all the smaller fisheries on the cape and the islands, are somewhat as follows: A "catcher" is elected by the selectmen, whose duty it is to catch the fish, and who receives in compensation the small amount paid by the citizens. Each citizen of Sandwich is allowed to buy one barrel of alewives, by paying from 35 to 70 cents, according as the supply is large or small. Those who are at the river at a certain time in the morning draw lots for their turn in being served, and if the supply comes to an end before all have been served those who are unfortunate enough to stand at the end of the list are forced to go away without receiving any fish. The fishery is prosecuted only for four days each week.

At West Brewster a committee of three manages the affairs of the alewife fishery, and the citizens receive only one-eighth of a barrel each, for which they pay at the rate of 3 cents per dozen fish.

The days on which the fishery may be carried on, and their number, vary in different towns. At West Brewster, until 1879, alewives were taken every day except Sunday, but since then only three days each week. At Wellfleet, too, the number of days is three, namely, Monday, Wednesday, and Friday. At Bass River and at Sandwich, as already stated, fishing is allowed on four days each week.

A number of the more profitable fisheries are sold by the towns to private parties annually at public auction, but in most cases with the agreement that a certain fixed quantity shall be sold to the citizens at a very low or nominal price. At Bass River each citizen of Dennis and Yarmouth may buy four hundred herring, at the rate of 40 cents per hundred, and at Wellfleet the lessees of

the stream pledge themselves to sell fish to citizens of the town at one-half a cent apiece. Citizens of Harwich may purchase fish at a low price at the stream, which flows between that town and Dennis, every evening except Saturday, when the people of the latter town have the sole right.

PRIVATE FISHERIES.—In addition to the public streams there are a number of others, owned and controlled by private parties. They are usually artificially formed, and connect ponds near the shore with the salt water. Such an one was opened at Waquoit about sixteen years ago, and more recently another at West Dennis. The fishery in these artificial brooks is quite as successful as that in the natural streams.

METHODS OF CAPTURE.—At South Yarmouth a number of sweep-seines are employed exclusively for alewives. In 1877 four were used, but in 1878 only one. The men fish off Bass River, but are restrained by law from approaching within one-half mile from its mouth, because they would then affect the success of the fishery in the river.

Large quantities of alewives, together with other species, are taken in the weirs and pounds, especially those located on the south shore of Cape Cod and north shore of Martha's Vineyard. In the weirs of Chatham, and in certain others at Waquoit and Falmouth, in use only in spring, a very large proportion of the total catch consists of alewives, the remainder being principally menhaden and sea-herring. At Harwich and Falmouth a number of gill-nets are employed, in which considerable numbers of alewives are taken, together with two other species, sea-herring and menhaden.

DISPOSITON OF CATCH.—The alewives taken in the streams are almost universally smoked or salted, while those taken in weirs and pounds are generally sold fresh to fishing vessels, to be used for bait. At Wellfleet they are salted and dried and sold in bulk, and the same is the case at West Dennis. About one-half the yield of the Bass River fisheries is pickled, and the remainder smoked. There are three smoke-houses near the pond, together worth about $100. Prior to 1879 the alewives taken in the Centreville stream, in the town of Barnstable, were all pickled, but in 1879 a considerable portion was sold to fishing vessels, and a few were smoked. The "catcher" at Sandwich usually smokes a few fish and sells them to the citizens. In Tisbury, one-tenth of the catch is reserved by the town and sold to pay for keeping the stream free from weeds. This tenth part of the catch is annually purchased by a certain dealer at Holmes Hole, who in turn sells the fish to fishing vessels for bait. At the Harwich River fisheries four men and five women are employed in salting the alewives.

VALUE OF FISHERIES.—The fisheries of Wellfleet and Harwich and Bass River, which are leased at auction, bring different prices in different years, according to the competition among the bidders, and the apparent prospect of a large or small catch. Harwich River fishery was leased in the spring of 1879 for five years, at the rate of $600 per year. The average price paid for the Bass River fishery is $700, but large quantities of white perch are taken in this stream, the value of which is considerable.

The price paid for alewives by fishing vessels is about 1 cent apiece, and of smoked alewives about the same.

The total quantity of alewives taken in Barnstable County in 1879 was 1,150,295 pounds, valued at $7,048.

4. FISHERIES OF THE MERRIMAC RIVER.

Of the two principal tributaries of the Merrimac, one—the western branch—rises in the White Mountains and forms a junction with the other—the eastern branch, which flows from Lake Winnipiseogee—at the town of Plymouth. Prior to the erection of obstructions on the Merrimac

and its tributaries there was an abundant run of shad, salmon, and alewives into the river, which furnished profitable fisheries to the inhabitants. Curiously enough, at the junction of the two rivers, the salmon and the shad separated, the former, entering the colder waters of the western branch, penetrated as far up as its sources in the White Mountains, while the vast schools of shad and alewives turned into the warmer waters of the eastern branch, which they ascended each spring for the purpose of spawning.

The fisheries of the Merrimac are at the present time insignificant, the entire product, according to the reports of the State fish commission, being only 2,139 shad, 32,400 alewives, and 3 salmon. Subsequent to the erection of the Lawrence dam the run of salmon into this stream was entirely destroyed. Energetic efforts for the restoration of this fishery have, however, been made by the New Hampshire and Massachusetts State commissioners, with some prospect of success. The fish-way at Lawrence, over a dam some 27 feet high, has proved available for the ascent of salmon, which, in small numbers, have passed up it each season since its erection, and have thus been enabled to reach their spawning-grounds. It is probable that protective legislation in conjunction with the measures above alluded to, and the erection of an efficient fish-way over the dams at Lawrence, Lowell, and Amoskeag will finally result in the restoration of these valuable fisheries.

5. THE EXETER RIVER, NEW HAMPSHIRE.

During May and June ten weirs are employed in securing the alewives that come up the Piscataqua into the Exeter River. The average yearly catch is 2,500 barrels, but has fallen short the past two years. In 1879 it was about 2,000 barrels, and was disposed of at Portsmouth. There are forty men employed and $3,000 capital invested in the fisheries of those two towns. The fisheries of the Piscataqua are discussed at the end of the next chapter.

8.—THE RIVER FISHERIES OF MAINE.

By C. G. Atkins.

1. GEOGRAPHICAL AND CLIMATIC RELATIONS.

The State of Maine, occupying the extreme northeast corner of the United States, lies between the parallels of 43° and 48° north latitude and the meridians of 67° and 71° 10′ longitude west from Greenwich. Its climate is variable, the thermometer moving sometimes through forty degrees of Fahrenheit's scale within twenty-four hours, changes of wind occurring frequently and suddenly, and the distribution of rainfall through the year being frequently irregular.

The mean annual temperature averages 42°.36 F. The mean of January, the coldest month, is 15°.79, and of July, the warmest month, is 67°.85. As extremes there occur almost every year maximums of over 90° and minimums of —15° to —35°.

The precipitation at Orono* has averaged 43.6 inches annually, including the snowfall, which had a mean annual depth of 92.96 inches and constituted about 44 per cent. of the total precipitation. Near the coast there is less snow and farther in the interior considerably more. The distribution through the year (deduced from the mean of sixteen years) is pretty even, the dryest month being June, with a mean of 3.06 inches, and the wettest, October, with a mean of 4.87

* The generalizations of air, temperature, and rainfall are drawn from observations by President M. C. Fernald at the State College, Orono. This station is near the geographical center of the State.

inches. The fluctuations of the same month from year to year are illustrated as an extreme case by the record of October, which shows a fall of 1.14 inches in 1874 and 9.57 inches in 1869. As compared with other regions, it appears that Maine has a rainfall a little in excess of that of the other Northern and Middle States, less than that of Oregon and the Gulf States, and greatly exceeding that of England, France, or Germany. The evaporation has been estimated at 60 to 65 per cent. of the rainfall, and the remaining 35 or 40 per cent. is discharged through the rivers.

The area of woodland in Maine has probably changed but little since 1869, when Mr. Wells estimated it at 21,200 square miles, or 67 per cent. of the entire surface of the State, of which 61 per cent., is primeval forest.* The latter lies in two principal bodies, which are also contiguous, the first by far the greater, occupying the northwestern part of the State, and comprising the northern portions of Oxford, Franklin, Somerset, Piscataquis, Penobscot, and part of Aroostook Counties; the second in the southern part of the State, in Hancock and Washington Counties, and extending at several points quite to the sea. The head waters of all the large rivers and many of the small ones are in the wooded districts. These forests consist largely of coniferous trees, spruce, hemlock, pine, and arborvitæ. They contribute in several ways to a constancy in the flow of the rivers. The ground is carpeted with moss and leaves, which check the surface flow of water during and after rains, and in the spring the trees shield the vast masses of snow covering the ground from the sun and winds, and cause it to melt gradually. The woodland streams are also free from the mud and other pollutions that are washed in from cultivated fields and drains of cities and villages. Amid these forests, moreover, lie the natural breeding-grounds of the salmon, which are doubtless safer there from pursuit than they would be in populous districts.

The extreme head waters of the largest rivers, the Androscoggin, Kennebec, Penobscot, and Saint John, are within 75 miles of each other along the western border of the State in the highlands forming the water-shed between the Gulf of Maine and the Saint Lawrence River. From this elevated region, of which the valleys are from 1,500 to 2,000 feet above the sea, and the mountain peaks from 1,000 to 2,000 feet higher, streams radiate in all directions, those of Maine flowing towards the northeast, east, southeast, and south.

A secondary water-divide stretches across the State from west to east in latitude 46° 10′ and separating the Penobscot from the Saint John basin. This is not coincident with the Appalachian hills, which lie mostly to the south. The elevations of this divide are from 1,500 feet in the west to about 500 feet in the east. The surface of the State is thus divided into a northern slope of 7,500 square miles, and a southern slope 25,000 square miles. The former has a gentle inclination to the north and east, and is wholly drained into the Saint John. The latter embraces that portion drained by rivers emptying into the Gulf of Maine within the limits of the State, and has in the western portion a southeasterly and in the eastern portion a southerly inclination, with many local irregularities. The southern slope is for the most part accessible naturally to the anadromous fishes, but the greater part of the northern slope, about 5,000 square miles, is cut off from the sea by the intervention of the impassable Grand Falls of the Saint John River, in New Brunswick.

2. CHARACTERISTICS OF MAINE RIVERS.

DECLIVITY.—The rivers of Maine are characterized in the first place by a considerable yet moderate descent. The surface of the main slope rises very gradually from the sea to the head-waters, and the river beds are sunk very little beneath the general plane. A fall of 1,085 feet in 140 miles, or 7.8 feet per mile, may be taken as representing the mean declivity.† Some of the

*Wells, Water-power of Maine, page 24. †Wells, Water-power of Maine.

river beds in the western part have a slightly steeper incline, and some in the eastern a more moderate one. The declivity is in general well distributed through the course of the river, but is in nearly all cases greater at a distance from the sea, and its uniformity is much broken by the occurrence of abrupt falls and lakes. The falls are not often precipitous or sufficient to prevent the ascent of fish, though this sometimes occurs, as at Hiram on the Saco, East Rumford on the Androscoggin, and on several tributaries of the Kennebec.

LAKES.—The great number of lakes that dot the surface of the State forms a striking feature in its topography. On the published maps there are represented 1,620, varying in size from 100 acres to 120 square miles, and it is probable that several hundred more above the minimum in size are unrepresented. Their depths are in no known case very great, but few of them exceed 100 feet, and many with an area of several square miles have in no place a greater depth than 50 feet. One of the deepest is Lake Sebago, which has in one spot 410 feet of water. The lakes exert a favorable influence on the rivers as homes of migratory fishes in various ways. They serve as regulators of volume, preserving from extreme low stages, and as clarifying basins in which the sediment borne by the tributary streams is deposited. They afford breeding grounds for alewives and possibly retreats for salmon during the summer preceding and the winter following their spawning season.

RIVER BEDS.—The stony character of most of the soil of Maine and the rapid flow of the rivers combine to give the latter in general a clear hard bed of rock *in situ*, or of bowlders and gravel, with, however, occasional stretches of muddy bottoms and banks.

In the western part of the State the lowland adjoining the rivers is often composed of sand, which in that case forms the banks and sometimes part of the river bed. As a whole these rivers abound in the gravelly rapids to which salmon resort for spawning purposes.

PURITY OF WATER.—There is in the soil of the State comparatively little material that is readily taken up and held long in suspension by the streams and rivers. The occasional turbidity following a sudden and excessive fall of rain in the disforested districts soon disappears through the precipitation of the earth in suspension. The lakes also are immense clarifying basins, and discharge waters of great purity. The waters are, in most cases, strongly tinged with brown from peaty or earthen solutions, and the general color of the water, both of rivers and lakes, when seen in great depth, is an inky blackness, though when examined in a small receptacle, as in a goblet or pail, they appear of crystal purity.

VOLUME.—Of the total rainfall it may be assumed that 65 per cent. is evaporated and the remaining 35 per cent. is discharged by the rivers into the ocean. This calls for a mean delivery of 67.44 cubic feet of water per minute (35,452,000 cubic feet per annum) for each square mile of area drained. Applied to the Penobscot, this ratio indicates a mean discharge of 498,000 cubic feet per minute.

The fluctuations in the volume of a river are governed by several circumstances, of which we may mention, first, the irregularities of precipitation; second, the variation of the evaporation with the changes of weather and the season; third, the area of storage basins in the shape of lakes, and the extent to which they are brought into use. Many rivers of the second class have such extensive storage basins that the volume is very constant, the variations of level rarely exceeding 2 or 3 feet. But on the Kennebec and Penobscot a variation of 8 feet within four months is not very rare, and a difference of 6 or 7 feet between flood and drought is the rule. For instance,* on the

*These data are furnished me by Mr. W. W. Fellows, engineer in charge of the water works, from personal observations.

first day of April, 1877, the Penobscot stood 7.25 feet above the dam at Bangor; through April it ranged from 7.25 to 4.75 feet; through May from 4.8 feet to 1.9 feet; through June from 1.9 to 1.4 feet; through July from 1.5 to .08; and in August it stood for a few days at the minimum of one-half foot. On the 29th of the following November it had risen to 6.25 feet; in December it fell from 5.9 to 1.5 feet; but through the whole of the following February (1878) it stood at 6 and 7 inches (.5 and .6 foot). The highest stage for the spring of 1878 (6.46 feet) was attained in April; the lowest stage for the summer was 15 feet, in August; the lowest for the year was 6 inches, October 1 (with flush boards on the dam); and the highest for the year was 9.2 feet, December 14. In 1879 the maximum (8.85 feet) was attained May 3, and during that month the water averaged higher than in April; it was low (15 inches) July 17, and still lower (1.3 inches) October 19. In 1880 the highest water was in May and the lowest between August 17 and October 24, during all of which time an extreme drought prevailed, the water standing just at the crest of the dam or an inch or two above or below it. Thus in four years we have seen the water at its highest stages twice in April, once in May, and once in December, and the lowest stages once in February and October (the same year), once in October alone, once in August alone, and once extending from August to October. The data existing on the subject are scanty, and the best generalization to be made must be founded partly on general observation, and would be as follows: The Penobscot is at its highest stages generally, but not invariably, in April or May; it is fairly full from March to July, inclusive, and never experiences a drought during those months. The lowest stages occur in August and September, often extending into October. In the winter there is generally a depression, which in some instances reaches the stage of a drought. The discharge of the Penobscot has been estimated by an expert* at 117,000 cubic feet per minute in a severe summer drought, and at 5,760,000 cubic feet per minute in a heavy freshet.

WATER TEMPERATURE.—Ice from 15 to 24 inches thick covers all the fresh water during the winter. On the lakes it forms about November 15 or 20, and melts out in April, commonly near the close of the month, in the southern part of the State. In the more northerly or elevated lakes it does not melt until May 10 or 15. The larger rivers, the Kennebec and Penobscot, are closed to navigation (at the ports of Gardner and Bangor, respectively) about four months or four and a half. The melting of the snow in the spring produces a flood which clears the rivers of ice in April two or three weeks before the melting of the lake ice.

During the winter the temperature of the rivers is generally within one degree of the freezing point, but after the breaking up of the ice it rises rapidly, and through the summer generally ranges from 60° to 70° or higher, in those parts above the influence of the sea.

TIDAL PARTS OF RIVERS.—The tidal portions of the Maine rivers are for the most part of considerable extent. In the Kennebec the rise and fall of the tide is felt as far as Augusta, 44 miles from the sea, and before the erection of a dam at that point it was perceptible some 10 miles farther. In the Penobscot the influence of the tide extended originally to Eddington, 30 miles above the mouth of the river, or, including Penobscot Bay, 60 miles from the sea. In the other rivers the tidal portions are less extensive absolutely, and in many of them likewise relatively, to the size of the river. The Androscoggin is not affected by the tide above Brunswick 25 miles, and the Saco only to Biddeford, 5 miles from the sea. The actual penetration of the sea-water is confined within narrow limits. On the Kennebec the water does not contain salt enough to support a growth of marine algæ above Bath, 12 miles from the sea, though in seasons of great

*H. F. Mills, C. E., quoted in Wells's Water-power of Maine, p. 105.

drought the water becomes brackish above Richmond, 14 miles farther up, and the flood-tide is strong enough to reverse the current some 10 miles farther still. On the Penobscot marine algæ are not found above Winterport, 18 miles below the natural head of the tide.

The brackish portions of a river have a lower temperature than the fresh portions, varying with the proportions of sea water present. The ocean water on the coast of Maine has a lower temperature than the fresh rivers all the summer season, from May to October, inclusive. When the salt and fresh water meet they do not immediately commingle, but the fresh water, being lighter, flows out on the surface and the salt water sinks to the depths. On the flood tide a strong inflowing current of salt water exists at the bottom often while the surface current is still flowing seaward. The salt water in the lower stratum, exposed over its entire upper surface to the fresh water, slowly commingles with it and rises, to be replaced by the constantly renewed flood from the sea.

The most of the rivers empty into broad estuaries before reaching the open sea. The most notable example is the Penobscot, whose estuary is 30 miles long and 20 wide at its mouth. The most notable exceptions are the Kennebec and the Saco, whose lower courses are confined in narrow channels quite to their entrance into the open sea.

The river fisheries are mainly carried on in the tidal portions, where strong flood and ebb currents alternate. Weir fishing is never attempted above the flow of the tide, and the most common form of weir depends for its working upon the retreat of the tide, which leaves the fish stranded upon a floor.

The tide averages about 11 feet rise and fall, varying from 8½ feet at Saco to 18 feet at Eastport.

ARTIFICIAL CONDITIONS.—The artificial alterations in the condition of the rivers are very considerable. They arise in part from the cultivation of the soil, but mainly from the erection of dams and the throwing of refuse from the saw-mills into the water. The exposure of the bare earth to the action of rains, as in all cultivated fields, especially in hilly districts, results in the washing of great quantities of soil into the rivers, where it settles in all places not swept by strong currents, but more especially near the mouths of the rivers. From the first occupation of the country* until very recent times it has been the general custom to throw into the river all refuse from the saw-mills, including not only sawdust but shavings, edgings, and in many cases even slabs.

* The aboriginal population of Maine does not appear to have been at any time very dense. It has been estimated at 37,000 in 1615, but the data are exceedingly meager and this may be erroneous. About that time they were greatly reduced by intertribal war, and still more by a destructive pestilence, by which it is believed that whole tribes were nearly exterminated. Between 1675 and 1758 they were involved in repeated destructive wars with the whites, by which many perished and many more were driven to emigrate to Canada. By the close of the eighteenth century but a few hundred remained. The coast was much frequented by European fishermen at the beginning of the seventeenth century, and the first settlements were mere fishing stations, located at points convenient for the capture and curing of cod and other marine species. The trade in furs early attracted attention, and many posts were established at accessible points on the coast and larger rivers, mainly with an eye to trade. After the fishermen came the lumbermen, attracted by the magnificent forests of timber which covered the whole land with the exception of the corn fields of a few thousand aborigines; and after all there came the white tillers of the soil. The earlier settlements experienced many vicissitudes; some of them were abandoned after a few years existence, and many were swept out of existence by their savage foes; but there are some settlements that have been continuously occupied from as early a date as 1623, and many others that can claim almost as long an existence, with the exception of a temporary suspension in consequence of Indian hostilities. Yet so slow was the increase in population that in 1675 (just before the beginning of the Indian wars) there were but 6,000 people in the whole State, there being at that time from 120,000 to 150,000 in all New England. In 1675 a desolating Indian war broke out, and the progress of settlement was arrested for about forty years. In 1735 the white population is estimated to have been 9,000; in 1743 there were eleven towns and 12,000 people. Wars with the Indians finally closed in 1758, and a year later fear of their renewal was allayed by the conquest of Canada from France. Immediately after this began an extensive immigration from Massachusetts, which continued uninterruptedly for more than half a century, and brought the population from 24,000 in 1763 to 96,540 in 1789, 298,269 in 1820, and 399,455 in 1830. The population in 1880 was 648,936.

Some of these materials were sufficiently water-soaked to sink at once to the bottom; others floated many miles, some of the coarser sorts even to the open sea; but sooner or later all of the sawdust and a great part of the other refuse sank to the bottom. The coarse and heavy portions resisted the action of the currents much more than the sawdust alone could have done, and the interstices being filled with sawdust and mud, deposits were thus formed that after the lapse of years came even to obstruct navigation.

The degree to which the fisheries are affected by this refuse is not easily determined. So long as it remains in suspension it does not seem to deter fish from ascending a river, though swimming thickly in all the strata of the water from the surface to the bottom. Where it settles to the bottom, however, it undoubtedly destroys all those animals that find their home in the sand and gravel and mud of the natural bottom, and to that extent deprives young fishes of their natural food. It is not unlikely that this may have had much to do with the disappearance of shad and bass from some localities.

Of a more serious character are the changes resulting from the erection of dams. Almost every stream in the populated parts of the State large enough to turn a saw-mill has been thus obstructed at from one to a dozen points in its course. The dams were with scarcely an exception built in utter disregard of their effect upon the fish, and in the majority of cases no adequate fish-ways were provided. The breeding grounds of salmon, shad, and alewives were therefore greatly curtailed in all the rivers, while in others they were entirely cut off. For example, in the Kennebec River the building of the dam at Augusta in 1837 completed a chain of obstructions that reduced the range of shad in that river and its tributaries from 150 to 50 miles, and that of salmon from about 300 to 50 miles. These figures do not, however, represent the injury done to those fisheries, which is measured rather by the reduction of the area of spawning-ground. This, in the case of the salmon, was from perhaps 50 miles of rapids to less than half a mile, and in the case of shad from 100 miles of gently flowing water to about 25 miles. It would be difficult to arrive at an exact estimate of the amount of the injury thus done, but I deem it safely within bounds to estimate the diminution of the productive capacity of the rivers at 90 per cent. from this cause alone.

The revival of interest in the river fisheries, which began in Maine in 1867, has given rise to renewed efforts to facilitate the passage of fish up the rivers. Improved forms of fish-ways have been devised and constructed in many places, yet but a small proportion of the waters affected have been as yet reopened.

3. NATURAL AND ECONOMIC HISTORY OF THE RIVER FISHES.

LIST OF SPECIES.—The river fisheries of Maine aim at the capture of the following species: Salmon (*Salmo salar*), shad (*Clupea sapidissima*), alewife (*Clupea vernalis*), smelt (*Osmerus mordax*), striped bass (*Roccus lineatus*), eel (*Anguilla rostrata*), tom-cod (*Microgadus tomcod*), and sturgeon (*Acipenser sturio*). The blueback alewife (*Clupea æstivalis*) is also caught to some extent in the weirs that are built for the true alewife, and in some cases the two are confounded. White perch (*Roccus americanus*) are rarely taken, this species being in Maine mostly confined to the non-tidal fresh waters. As a neglected species may be mentioned the lamprey, which occurs in nearly or quite every river, but is rarely utilized in any way.

THE SALMON (SALMO SALAR).

NATURAL HISTORY.—The salmon of Maine (*Salmo salar*) is identical with the salmon of all the rivers of Eastern North America and Europe. A brief statement of the principal points in its natural history will suffice. It enters the rivers in the spring and summer, beginning and

completing its run earlier in the central and western part of the State than in the eastern. In the Penobscot it is sometimes taken near Bangor in the month of March, and always early in April. It is more abundant in June, and the catch practically ceases early in July. Those individuals that succeed in escaping capture, reach the upper waters early in the summer and lie there quiet until their spawning season, which is the last of October and the first of November. They lay their eggs at night on gravelly shallows, covering them loosely with gravel. The old fish return to the sea mainly in the spring, spend one entire year in recuperation and further growth, and the second year again visit the rivers for spawning. The eggs lie under the gravel, slowly developing, from November till May, when they hatch. The young salmon feed in fresh water one or two years, then descend to sea, and after the lapse of a period not definitely ascertained, but probably two or three years, revisit the rivers as adults, weighing from 9 to 14 pounds. The general average of adults taken is about 13 pounds, but it varies from year to year, being sometimes less than 12, and sometimes (rarely) as high as 18 pounds. Salmon eat nothing while in fresh water, constantly falling away in weight and deteriorating in quality. They swim mainly by day and near the surface.

It is well ascertained that salmon originally frequented the following rivers, viz: The Piscataquqa, Mausam, Saco, Presumpscot, Royals, Androscoggin, Kennebec, Sheepscot, Medomak, Saint George, Penobscot, Union, Narraguagus, Wescongus (Pleasant River), Machias, East Machias, Orange, Denny's, and Saint Croix. At the present day they are found only in the Androscoggin, Kennebec, Sheepscot, Penobscot, Machias, East Machias, Denny's, and Saint Croix.* In the Androscoggin only a few are found, seeking to ascend the river; in the Sheepscot only occasional specimens are observed; of the Machias about the same may be said; in East Machias the yield is unimportant (only 35 in 1880); the Denny's has of late yielded from 200 to 1,000 yearly, the Kennebec about the same, the Saint Croix from 100 to 500, and the Penobscot from 5,000 to 15,000.

MODES OF CAPTURE.—Salmon are captured with spears, dip-nets, drift-nets, set-nets, weirs and traps, or pound-nets. The spears have only been used by the Indians, and appear to have been their ordinary, if not exclusive, implement for the capture of this fish. An Indian spear of the present day consists of a wooden handle, a straight, plain terminal spike of steel, and a pair of wooden jaws on opposite sides of the spike. When a fish is struck the spike pierces the body, the jaws spring apart, and then close upon the body of the fish and hold it securely. They are plied at night, by torchlight, from a canoe. Dip-nets have been in use since the occupation of the country by Europeans to capture salmon in difficult places about falls; but on nearly all rivers it is now unlawful to take anadromous fishes in such places, and therefore dip-nets are not much used for salmon-fishing.

Drift-nets and set-nets.—Drift-nets and set-nets take salmon (and other fish) by enmeshing them. They have a large mesh, from 6 to 7 inches, and are essentially alike, being simple straight nets, buoyed at the top and leaded at the bottom. The same net may be used in either way, and in early times such was a very common practice. Previous to the present century the salmon of the Maine rivers were taken almost wholly by meshing nets, either stationary or drifting. At points where the shore was bold a net would be set directly from it, the shore end being made fast to a stake and the outer end kept in place by killocks anchored off at proper distance. On a gently-sloping shore the fisherman would build a brush hedge to a suitable distance from shore and set the net at the end of that. The size of these nets was not uniform, but a common length

*Single specimens are indeed sometimes taken in other smaller streams, as the Harrington River, but these are considered strays.

was 40 feet, for use on a bold shore; the prevailing mesh was 7 inches, stretch measure, and the common depth twenty meshes, or about 8 or 9 feet; they were knit at home, of hemp twine of medium weight. In 1814 the length of nets set in the Penobscot River, including any other contrivance to which they might be attached, was limited by statute to one-third the width of the stream where used. The use of set-nets for salmon has been generally abandoned on the Penobscot and Kennebec since the erection of weirs became common, but is continued in Denny's River to a small extent.

Drifting for salmon was formerly practiced in all the salmon rivers. In the Kennebec and Penobscot the drifting-ground was the whole length of the river, though of course the best spots were just below obstructions, on the Kennebec at Waterville and on the Penobscot between Bangor and Oldtown. After the building of dams these grounds were changed, and were always below the lowest obstruction. As the salmon became scarcer drifting on the lower courses of the rivers was gradually abandoned. It is now practiced more or less on the Saint Croix, Penobscot, and Kennebec, but the recent laws forbidding fishing within 500 yards of a dam or fishway have greatly discouraged it.

Angling for salmon has been successfully practiced for many years in Denny's River, and it is probable that the lack of success that has thus far attended its trial on the Penobscot is attributable to transient causes.

The salmon weir.—The most radical difference in the river weirs concerns the mode in which the captured fish are removed. In the most common forms the fish are finally entrapped in an inclosure of rather small size, provided with a board floor, upon which they are left by the retreating tide, and upon which the fisherman comes and picks up his catch. Upon the Kennebec River there is in use a weir of which the "fish-pound" is a large inclosure, with no floor but the bottom of the river, from which the fish are removed by means of a small seine operated from a boat, which is pushed into the inclosure. This is known as a "deep-water" weir, and as its use is mostly or wholly confined to the Kennebec River, where the shad is the main object of pursuit, it will be described in connection with the remarks on shad. The kind first mentioned, which may be called a "floored weir," will first receive description.

For an example of a typical floored weir we may take the Penobscot salmon weir. This generally consists of a "leader" and three "pounds." The leader is a straight fence running out from shore, generally at right angles with it, constructed of stakes driven firmly into the ground 2 or 3 feet apart, and woven with brush or, rarely, hung with nets. Its length varies according to the natural features of the locality. It is always sought to place the pound in the channel, or, in case that is not attainable, in as deep water as can practicably be reached, generally from 10 to 20 feet at low water. In some cases broad "flats" intervene between the shore and the chosen site for the pounds. In other cases the bottom slopes off steeply into the deep water and powerful currents of the channel. The former may require a leader a third of a mile in length; the latter less than 50 feet. The outer end of the leader stands in the middle of the entrance to the outer pound, dividing it into two parts, which occupy the base of the large, symmetrical, heart-shaped figure formed by the walls of the inclosure. The entrance (embracing both sides of the leader) is about 22 feet wide; the pound is about 60 feet in extreme width and 60 feet in length. It is generally built of brush, not rarely in whole or part of netting. It has no floor. At its apex it opens by a narrow entrance into a smaller inclosure, the "second" pound, which has a floor above low-water mark. The second pound is also heart-shaped, is 18 feet wide, is always made of netting, or, as termed on the Penobscot, "marlin." It leads by an entrance but 12 inches wide into an oval "fish-pound." This is also floored and built of the best and strongest netting.

Around the edge of the floor runs a single upright board, the "ribbon board," to which is attached the lower edge of the "marlin," which is thus relieved from the force of the struggles of the fish when they find themselves about to be stranded on the floor. The floor is of rough boards, and the cracks between them are sufficient to allow the water to drain out freely. The entrances of the second and fish pounds are tunnel-form, the sides standing to each other at an angle of about 80 or 90 degrees, and the outer entrance approaches the same form. The stakes employed in weir-building are commonly of black spruce, an abundant tree in the fishing districts, which grows straight, slender, and smooth, and affords strong and elastic wood. The brush is oftenest alder or white birch, but other kinds are also used. The netting is always of cotton, from the twine described as "18-thread, No. 20," with meshes 1¼ inches square, or what is known as a two-inch-and-a-half mesh," and tarred before being put to use. It is woven to accommodate the entire height from the floor to extreme high-water mark. When a new piece is bought it is placed upon the fish-pound, and the older pieces are used on the outer and second pounds, where they last several years.

The ordinary sites selected for salmon weirs are on muddy bottoms, and the entire structure even to the floors, is supported by stakes or posts thrust or driven into the ground by workmen operating from a scow. The brush is woven in with the stakes above water and then pushed down, one piece at a time, by a crotched pole or an iron implement made for the purpose. The closeness of the work varies much, but it is not thought advisable to make a very close matting, as that would hinder too much the passage of the currents through it and would render some parts, especially of the outer pound, too dark. Where netting is applied, it is rarely put below low-water mark, the lower parts being of brush. The substitution of net for brush appears to have operated favorably by facilitating the passage of currents. The old-fashioned fish-pound, woven of brush so close that fish could not escape, was a comparatively dark, stagnant inclosure, and a very inefficient arrangement compared with the modern netted pound.

There are many variations from the typical weir above described, most of them of slight importance. In some cases there are but two pounds; in others there are four. In ordinary sites the pounds project, one beyond the other, into the river; but where the bottom slopes off too steeply for such an arrangement the series is produced parallel with the shore. In some districts the entire bottom is too hard for staking, and the weirs are built in sections with timbered bottoms in which the stakes are fixed, and which are towed to the proper place, sunk, and ballasted with stone. On exposed shores it is sometimes necessary to support the principal parts against the force of wind and waves by guy-ropes attached to heavy moorings. Instead of the shore the outer extremity of a weir is sometimes made the base from which to start the leader of another weir. On the Kennebec floored weirs are for the most part confined to shoal water, another form, to be described below, being employed in deep water, and a slightly different nomenclature prevails.

The cost of building a salmon weir with a long leader, all new, may be put at from $80 to $100, including pay for the labor, which, however, is mostly performed by the proprietor. To keep up the same weir, including necessary repairs, would cost from $50 to $80 per year.

The received theory of the operation of these weirs is that the migratory fishes, moving up or down the river along the shore, are intercepted by the leader, and, in striving to pass it, fall into the outer pound, which is of such form that, once within it, the fish rarely succeed in finding the path by which they came, the curved sides, which they follow, leading them constantly past the outer entrance and directly toward the second pound, which in turn conducts them to the fish pound, the whole arrangement being based upon the propensity of fishes to move in straight lines

until turned aside by some obstruction. Its practical working proves the theory to be well founded; but some uncertainty exists as to the degree of perfection attained by the device and the ratio of fish caught to those encountering the weir and escaping. The testimony of some close observers indicates that a very considerable proportion of the salmon that are enticed into the outer pond, and some even of those that reach the fish pound, find their way out again. Whether there is utility in the two entrances, on the upper and lower sides of the leader, is also a matter of doubt, as it is not known whether as a rule the fish enter the weir on the lower or the upper side, whether with the flood or ebb tide.

The precise location of a weir for most effective work appears to receive less attention than the importance of the subject demands; yet it would not be correct to say that the fishermen are heedless in the matter. In nearly all the fishing districts since weir-fishing first began there have been many experiments tried in the location of weirs, and those sites that paid best have been selected and continuously occupied. The locations that have thus stood the test of experience are strictly regarded by their owners, and many of the best weirs have been built in the same position, with scarce the variation of a fathom, for a generation; for all this, it is probable that a careful study of the tides and currents and the influence upon their movements of the fish would lead to a change of location for the better in many cases. The observations of some intelligent fishermen have led them to the conclusion that the line of contact between a tidal current and an eddy is the place where fish (especially salmon) are most likely to congregate, and that the nearer the entrance of a weir can be brought to this line the greater will be its success, other things being equal. This is not so easy a thing to do as might at first appear. The position of an eddy line varies with the strength of the tides, the volume of the river, and the force and direction of the wind; so that a weir which is to-day in just the most favorable position may not be so again for a month. Sometimes for a whole season the mean position of an eddy line may be some rods away from its normal position. More generally recognized are the direct influences of the winds. Almost any fisherman will say "such a wind is favorable for me, but with such another I catch nothing." In general, it appears that a lee shore is better than a sheltered shore. Perhaps the wind influences solely by roughening the surface of the water, which in nearly all kinds of fishing is a favorable circumstance. Calms are universally unfavorable.

The pound net, or trap.—The pound net or "trap" (the ordinary term) in use on the Penobscot consists of the "run," the "inner pound," and the "outer pound." The run is a straight net running out into the water at right angles to the shore. It is 11 or 12 feet deep, and its length depends somewhat on the character of the site; 25 fathoms is the common length, but in very "bold" water 18 or 20 fathoms will answer. At the extremity of the run is the inner pound, which is shaped like an obtuse arrow-head, the two barbs being styled "hooks." The entrance of this inner pound, 6 feet wide, is between the barbs or "hooks," and at its tip is an opening 1 foot wide, which leads into the outer pound, an inclosure about 18 feet square. Both pounds have bottoms and are of the same depth as the run, 11 or 12 feet. The whole is supported by wooden floats, so that it rises and falls with the tide, and is held in place by anchors planted at the extremities of long "warps." The mesh employed is 6 or 6½ inches long, being 3 or 3½ inches square. This mesh is too small to enmesh a 22-pound salmon and too large to catch one of 6 pounds. It is supposed that if small salmon ever enter these nets they pass out through the meshes. The majority of the medium-sized and large salmon do not mesh, but remain free in the pound, being too wary to strike the meshes. The bottom of the net is commonly several fathoms above the ground; and were not the salmon that encounter its run persistent surface-swimmers, they would dive under it and escape without entering the pounds. The three parts first described constitute what the fishermen call a "hook

of nets." Sometimes from the outer extremity another run is set with pounds at the end of it, constituting another "hook of nets," and this combination is called a "gang of nets." Sometimes as many as four hooks are set in a single gang. The invention of this style of net is ascribed by the fishermen to one "Halliday, an Englishman," with reference, doubtless, to the same Halliday who introduced the use of netting or "marlin" on the weirs in the Penobscot River. The net in use before the introduction of the present form of trap had only one pound, corresponding to the inner pound. It was much inferior, as a great many salmon escaped by the entrance, which had to be wide to induce them to enter at all, and in this way the very largest salmon were always lost, being too large to mesh. Still farther back the pound was represented by a mere bend of the net at its outer end, and this was also preceded by the simple straight gill-net which was in common use for the capture of salmon in Penobscot River and Bay in the eighteenth and early part of the nineteenth centuries. The improvements were very gradually made, and as late as 1850 fishing with nets with only the bend at the extremity was common. The trap is used only in Penobscot Bay, and with the exception of a single net set in 1880 at Searsport, it is confined to the west side of the bay below Belfast, and to Long Island.

CURING AND MARKETING.—In the early days of the Maine salmon-fishery the bulk of the catch was either salted down in barrels or smoked. For smoking, the salmon were prepared by first splitting, removing the backbone, but leaving the head on, and salting for two or three days, according to the size of the fish. When sufficiently salted they were washed off, spread by applying thin braces of cedar or spruce across the back, and then hung up in the highest part of a little domestic smoke house. Constant exposure to the smoke for two or three days completed the process.

Salt salmon were to some extent consumed in local markets, but it appears that the greater portion was sent out of the State. Smoked salmon became early in the present century an article of traffic with the larger sea-ports of other States. Many were shipped on vessels laden with lumber and miscellaneous produce. Small vessels belonging in Southern New England used to visit several of the larger rivers annually and load with pickled shad and smoked salmon, buying a part of their salmon already smoked and smoking part themselves. This trade died out before 1850.

With the growth of the modern demand and the modern facilities for preservation and transportation, the practice of marketing fresh increased, and for many years it has been exclusively employed. For this purpose each fisherman has an ice-house and puts up a supply of ice every winter. As soon as caught the salmon are placed on ice. The dealers have like facilities, and in transportation the salmon are always packed in ice. There is a considerable local demand for salmon in the cities and villages of Maine, but this is partly supplied from the rivers of New Brunswick, and much the greater portion of those caught in Maine is shipped to Boston, where most of them are retailed.

THE SHAD (CLUPEA SAPIDISSIMA).

NATURAL HISTORY.—This is the common shad of the Atlantic rivers from the Saint Lawrence to the Gulf of Mexico. It is the finest in quality of all those members of the herring family that frequent fresh water, as it is of all the Clupeidæ of North America. In Maine it attains a size of 12 pounds, but this is extremely rare, the average being not far from 3 pounds, and the ordinary range from 2 to 5 pounds.

The shad is mainly a marine feeder, but it reproduces its kind exclusively in fresh water, spending several weeks in the rivers for that purpose in May, June, and July. The earliest shad

are taken in the Kennebec or tributaries during the last days of April, but the main run is in May and June. Before the erection of mill-dams the shad ascended the Kennebec and tributaries to a distance of 100 miles, and the Penobscot to a distance of 170 miles from the sea; and it is probable that their spawning-grounds in those days were largely in the quiet stretches of river above the influence of the tide. But in recent times their migrations have been restricted to the tidal portions of both those rivers, as also of nearly all the rivers in the State, and their eggs are all laid in water subject to the action of the tides, yet entirely free from salt. The earliest ripe spawn is observed the last week in May. Spawning doubtless begins before June 1, but is mostly performed in June, while the latest shad are not ready till July—possibly a few individuals not until August. The poor and shrunken shad that have completed the work of spawning are first seen on their return to the sea about June 20, and they are constantly met with through July. They begin to feed before reaching the open sea, and recover a good deal of fat and flavor before disappearing.

The eggs of shad have a slightly greater specific gravity than water. Extruded into the open waters, protected by their transparency, swayed hither and thither by the currents, they develop with great rapidity, and in three or four days, according to the temperature of the water, give birth to living fish. The young shad descend very shortly to sea.

Shad are believed to attain maturity in three or four years. A portion of the males have active sexual functions when a little larger than an alewife, and probably a year old. A more numerous class of immature individuals feed about the bays and in the mouths of the rivers during the summer later than the ascent of the main body of breeders. They are of smaller size, fatter, more numerous, with sexual functions dormant. The fishermen call these "sea shad," and consider them quite distinct from the "river shad" or "spring shad," but there is abundant reason to believe them merely the common shad at a particular stage of growth. They never ascend the rivers so far as the spawning shad, rarely showing themselves in any great numbers above the reach of brackish water. They frequent some salt bays entirely removed from fresh rivers; for instance, the northeast branch of Casco Bay, where fisheries for them have existed for many years, and have sometimes been quite productive. But these localities are in the vicinity of the Kennebec River, and I know of no instance of their occurrence at any great distance from a shad river.

The original range of shad in Maine included almost if not quite every river in the State; but in the smaller rivers it does not appear from the scanty evidence attainable that they were ever very plenty. From nearly the whole extent of some of the larger rivers they were excluded by impassable falls, and from many of second size they were shut out by mill-dams at so early a date that their former presence is attested only by a dim tradition. In short, there are only three rivers in the State in which it is quite certain that there ever existed an important shad-fishery. These are the Saint Croix, Penobscot, and Kennebec, and in the Kennebec alone has the fishery continued to be of considerable importance to the present time, while in but three other rivers and a few salt bays is there now any attempt to fish for shad.

Modes of capture.—Shad are caught in weirs, seines, drift-nets, and dip-nets.

Weirs.—The weir mainly employed at the present day for the capture of spring and summer fish in the Kennebec River, in which shad are the most important fish taken, differs from the salmon weir already described, in that the fish are not left by the retreating tide on a board floor, but in a deep and spacious inclosure, from which they are taken with a seine. They have been generally termed "deep-water" weirs, but, from the mode of operation, may be better styled "seine-weirs." The seine-weir commonly consists of three pounds, denominated, "first pound" or "pasture," "second" or "middle" pound, and "third" or "fish pound." The latter is an inclosure

of about 120 feet circumference, surrounded by a strong net running quite to bottom, its lower edge being weighted down with a heavy chain. When the tide is out the water in this inclosure is from 2 to 15 feet deep. It is "fished" about low water by sweeping it with a small seine,* and hauling the fish into a boat. The method of construction is similar to the floored weir above described, but more net and less brush is used. The net is of cotton twine from sixteen to twenty-four thread, meshes 2 to 2½ inches *in extenso*, is kept tarred (pine tar being preferred for fresh water), and lasts several years. These weirs were introduced on the Kennebec about 1852, and have proved far more effective than the floored or "pocket" weirs that preceded them. The most important advantages possessed by them appear to be the following: First, the fish can enter the fish pound readily at all stages of tide and on a level with the bottom of the river; second, the fish pound is more capacious; third, if fishing is omitted for a tide or two, the fish do not die, but have plenty of water to swim in until next tide.

The floored weir, already described as a salmon-weir, was, early in the century, the instrument of the capture of immense numbers of shad, along with alewives and salmon, in both the Kennebec and Penobscot. At the present time they furnish all of the few shad taken on the Penobscot, and many of them are still built for the mixed fishery of the lower Kennebec. Half-tide weirs, such as are described in connection with the alewives, were also formerly much employed for the capture of shad and alewives, especially on the Penobscot, but with the diminution of the supply have almost wholly gone out of use.

Seines.—A seine, in the common parlance, is a movable net by which fish are surrounded and captured either by pursing up the bottom or drawing both seine and fish ashore. All the seines employed in the river fisheries of Maine are of the latter class, and of a size requiring four men to each seine. The ordinary method of operating is to coil the net on the stern of a large seine-boat, from which it is "paid out" or "shot," as the boat is rowed out and back in a semi-circular course. From each end of the seine lines run ashore by which it is "hauled." All fish within the inclosed area are brought ashore except those small enough to slip through the meshes. Salmon, shad, alewives, bass, perch, and sturgeon may all come in together. It is necessary to have a smooth bottom and smooth shore, and be in close proximity to the channel where the fish run. Nature has fitted but few seining grounds on Maine rivers, and most of the grounds that have been used have been cleared up for the purpose, with a more or less considerable expenditure of labor. In consequence of this lack of facilities seines have never been extensively used. On the Kennebec and tributaries fourteen seining berths are enumerated as having been occupied in former times, but nearly all of them are now abandoned. On other rivers seines have been still less employed.

Drift-nets.—Drift nets were formerly largely employed for the capture of shad in all the rivers frequented by them, especially the Penobscot and Kennebec. This was an important industry down to 1840, or a little later, since which date it has entirely ceased in the Penobscot, and lost nearly all its importance in the Kennebec. At the present time 56 drift nets are plied in Eastern River, a branch of the Kennebec, and 66 more in the Kennebec and its other tributaries. In Casco Bay there are 90 drift-nets in use, but only for a few nights each season. The shad drift-nets of the present day are of about 4½-inch mesh, varying slightly in different localities. This size is adapted to sea shad. In Casco Bay they are knit of fine linen twine, from thirty-five to forty-five meshes deep and of various lengths, from 100 to 300 feet. When fishing in a broad

*The seine is a net fixed on two poles or "staves" at either end, with corks at top and leads at bottom. By means of a line running through rings around the bottom it is "pursed" or "tucked" after the ends are brought together, and the fish are thus bagged.

channel a single boat will sometimes put out 3 of these nets joined together. At Georgetown, on the lower Kennebec, they are 30 fathoms (180 feet) long and fifty-five meshes deep. In early times, when the large river shad were alone taken, a much larger mesh was used, 5¼ inches being the rule on the Penobscot. Drifting for shad is done only at night. In the rivers the ebb-tide is chosen, but in Casco Bay the state of tide is considered a matter of indifference.

Dip-nets.—Before the original abundance of shad had been much affected by the operations of man, productive dip-net fisheries for them existed at many points on the rivers where natural obstructions existed, which were nevertheless not impassable. Among these stations may be mentioned Waterville and Skowhegan Falls, on the Kennebec, and Salmon Falls, on the Saint Croix. At the latter point there was in use, in 1825, "a large dip-net attached to a long swinging pole like a well-pole. It was heavily leaded to make it sink in the swift water; it was then swung round, and it was not at all uncommon to take two or three barrels of shad at a single dip of the net."*

The only instance of a dip-net fishery for shad in recent times is in Nonsuch River, a very small stream, not over 20 miles in extreme length, in the town of Scarborough. The nets here used are about 9 feet deep and hung on wooden bows, 3 to 5 feet in diameter, with a long and heavy pole. When in use the bow rests on the bottom of the stream in the middle of the channel, which is very narrow, and the pole is supported by a crotched stake planted on the bank. The stake serves as a fulcrum on which to lift the net out of the water when the striking of a fish is felt.

METHODS OF CURING SHAD.—Three-quarters of all the shad now caught in Maine are marketed fresh. The rest are pickled. The proportion pickled has been constantly diminishing since about 1840 or 1845, at which date it embraced substantially the entire catch of the Kennebec and other shad rivers beyond those used in the local markets.

PROCESS OF PICKLING.—The inspection laws of Maine require pickled shad to be assorted in three grades, denominated "mess," "No. 1," and "No. 2." For the highest grade the fish is opened along the belly, the entrails removed, the body split so as to lay it out flat on its back, and the anterior two-thirds of the backbone cut out. As fast as dressed the fish are thrown into a tub with water, from which they are shortly removed to another tub of clean water (either fresh or sea water) in which they are laid, flesh side down, to facilitate the escape of blood. After lying here about two hours and being swashed about to wash off the blood and gurry, they are salted down in a hogshead tub to "strike." They are first thrown upon salt in a shallow box, rubbed in it, and, with the salt sticking to them, are placed in the tub flesh side up. If the crew is working fast and there is any danger of not getting on salt enough, more is thrown on as the filling progresses. There is no danger of getting too much salt. The "striking" takes one bushel to a hundred fish. The length of time required for this process depends upon the weather. If warm, three days is enough; if cool, four to six days may be necessary. If necessary the shad may be left in the striking-tub a month without harm. They are packed 4 inches above the top of the tub, but as the pickle makes they settle down to 1 inch below the top. As soon as they reach a certain point in the process of striking, commonly in two or three days, the fish rise in the pickle. The upper layer is then turned flesh side down, two or three quarts of salt spread on top and a moderate weight put on, just enough to keep them under the pickle. When the striking is completed the salt is rinsed off in the pickle, and 200 pounds of fish are weighed off for a barrel. As they are placed in the barrel salt is thrown on occasionally, half a bushel being thus employed for a barrel.

*Perley's Report on Sea and River Fisheries of New Brunswick, 1852, p. 125.

A convenient quantity of pickle is now poured in, the barrel is headed up, and then completely filled with pickle through the bunghole. The pickle used is the same in which the fish were struck.*

No. 1 differ from the mess shad merely in having the backbone in and the tails on. The third grade, No. 2, embraces thin and poor fish, but these, as well as the two higher grades, must be well preserved. An inspector must attend as the fish are packed and see that it is properly done. His brand is placed upon the head of the barrel, and if any purchaser finds the fish of inferior quality or in bad condition he can recover damages of the inspector.

It takes nowadays from one hundred and twenty to one hundred and thirty Kennebec River shad to make a barrel of mess. Previous to 1820 it took but ninety shad to the barrel. From 1820 to 1840 one could rely upon one hundred shad filling a barrel. After that there was a decline in size until one hundred and thirty were required to the barrel, which was the rate for some years previous to 1880. In the latter year, however, there has been an improvement in size, and one hundred and twenty are now sufficient.† The sea shad are much smaller. Of those caught in Casco Bay a barrel will hold one hundred and seventy-five. One informant estimated the number in a barrel in 1853 at one hundred and thirty or one hundred and forty, showing that these fish as well as the river shad have deteriorated in size.

The barrels now in use are almost wholly of spruce staves and pine heads, bound with twelve hoops, which are commonly of white ash. The law allows the use of white oak, white ash, pine, chestnut, and poplar for staves, and prior to 1850 pine was generally employed. Both Cadiz and Liverpool salt are in use. One experienced packer prefers to strike shad in Liverpool salt and use Cadiz in the barrel, considering the latter of superior strength, but the former better adapted to striking because finer.

The price obtained for salt shad varies ordinarily from $9 to $11, but as extremes may be mentioned $6 and $16.33 per barrel. The latter price was obtained for some lots at Richmond in 1867 or about that time. The high price combines with other circumstances to forbid the consumption of many salt shad at home. They are consequently nearly all shipped out of the State. For about twenty-five years previous to 1867 almost the entire catch went into the hands of a single firm in Boston, but since that date a considerable portion is shipped direct to Philadelphia, which market is reputed to ultimately absorb most of those sent to Boston and other points. At present this business is of little importance, but 384 barrels of shad having been packed in Maine in 1880. As an illustration of the decline in recent years may be adduced the statement that at Dresden as late as 1860 to 1865 there were packed from 200 to 400 barrels yearly, against 75 barrels in 1880.

THE ALEWIFE (CLUPEA VERNALIS).

NATURAL HISTORY.—The range of this species is from Florida to Newfoundland. In Maine it has a more gregarious character than any other river fish. It pushes up the rivers in dense bodies, which appear to seek unerringly each their native lakes, and the young descend to sea in solid columns. Before the obstruction of the streams by far the greater part of the alewives deposited their spawn in lakes and ponds. No stream seems to be too small for them if its waters are derived from a pond, and there can have been hardly an accessible pond in the whole State they did not visit. The inaccessible waters were those rendered so by the interposition of insurmountable falls or too great a distance from the sea. They are known to have ascended the

* Statement of W. W. Walker of Dresden. In other districts there may be some difference in the details.
† Statement of John Brown, W. W. Walker, and others.

Sebasti-cook, a branch of the Kennebec, to Newport, 100 miles from the sea, in great numbers, and on another branch, the Sandy River, tradition says that they bred in Temple Pond, about 120 miles from the sea. It is not probable that their migrations were more extensive than this in any part of the State, except on the east branch of the Penobscot, where tradition says they reached a point nearly 200 miles from the sea.

The main body of the alewives enter the rivers late in May; some rivers not until June. They move almost exclusively by daylight and especially in bright sunny weather. An unusual flow of water deters them from entering a stream. They are very courageous in the passage of falls, venturing into very small channels that promise to lead them past obstructions, and often forcing their way up inclined planes where the depth of water is not enough to cover their bodies. After spawning, the old fish soon return to sea, and the young follow them between July and September, when from 2 to 4 inches in length. The time that they require to attain maturity is estimated at three or four years. They do not appear to ascend the rivers more than once in a lifetime for any other purpose than to spawn.

The alewives frequenting the same breeding place are remarkably uniform in size and appearance, but between those of different streams there are remarkable differences, mainly in the matter of size. Among the largest are those of the Kennebec, of which three hundred and fifty will fill a barrel, while of the Damariscotta alewives a barrel holds four hundred and twenty-five, and of the Brooksville alewives seven hundred and fifty. The latter are the smallest known, but are very good fish.

There is another species (*Clupea æstivalis*) that is sometimes confounded with the alewife, *though nearly all fishermen recognize it as distinct. It enters the mouths of the rivers* several weeks later than the true alewife, does not appear to breed in fresh water, is of slightly different shape, smaller, of finer quality, but on account of excessive fatness is cured with difficulty and generally treated as refuse, to be employed as bait or as a fertilizer for the soil.

The ovaries of a Maine alewife contain about 165,000 eggs. With this high degree of fertility they combine a considerable degree of hardiness in both adult and young compared with other members of their family, and to these characteristics we may attribute the fact that they increase with remarkable certainty and at a rapid rate when afforded even ordinary facilities. The placing of a few hundred adults in a pond at the season of their ascent is surely followed by the descent of a throng of young a few weeks later, and the return of a considerable body of mature fish *after the lapse of three or four years. It is doubtful whether there is another among our whole* list of fish that will so well repay efforts at cultivation.

MODES OF CAPTURE.—Alewives are caught in weirs, seines, drift-nets, set-nets, and dip-nets. The weirs do not differ essentially from those already described as built for the capture of salmon and shad, along with which the alewives are taken in such waters as are frequented by those species. This method is in use in the tidal part of every river where alewives abound. The seines are the same as the shad-seines already described. They have recently almost wholly gone out of use, but are plied in a few localities, among which may be mentioned the lower part of Damariscotta River. Drift-nets, with a mesh of 2¾ inches, have been employed for catching alewives down to recent times in the Kennebec River, but have now been abandoned. They were cast *from a boat at night, the banks of the channel just outside of the weirs being considered the best* ground. There has never been a time when many alewives were taken in this way, and they are not known to have been so taken in any other river. Set-nets have been used only in a few localities and to a very limited extent.

The dip-net fisheries for alewives are next in importance to the weir fisheries. It is by this method that the alewives are taken at Damariscotta Mills, Warren, East Machias, and Dennysville. The dip-net is a very economical piece of apparatus, and requires no very expensive fixtures, but for its effective use it is essential that all the alewives shall be compelled to pass a narrow or difficult place within reach of the nets. This only happens in rivers where their spawning grounds lie above tide-water, and where obstructions, natural or artificial, exist.

The form and construction of the dip-net vary considerably in different localities. Those found of late in use at Damariscotta and Warren have wooden bows bent into an oval form 2 feet wide and seized on to wooden handles, the bag being knit of coarse cotton twine and hung about 3 feet deep; they are plied in narrow basins or artificial inclosures which the fish are allowed to enter. At East Machias, where the fish are dipped directly from the open river, they use larger nets 5 feet deep, hung on a steel bow 3½ feet in diameter, at the end of a pole from 16 to 17 feet long. Platforms are erected at points most convenient for dipping; generally along side a pool just below an obstruction, where the fish congregate. It is necessary that the water be swift and somewhat broken, otherwise the fish will dodge the net. Upon the platform are also the tubs or bins into which the fish are thrown as they are dipped. These fisheries are operated almost wholly in the afternoons of pleasant days. In cloudy weather the alewives are very backward about attempting the ascent past difficult places, and at night they invariably fall back into quiet pools, where they lie until the next day is well advanced. The run of fish lasts about a month, but the most of the catch is often effected during a single week at the height of the season.

The alewife fisheries have in numerous instances been from an early day held as municipal property by the towns in which they are located. They have been generally, if not always, appropriated in accordance with an enabling act of the legislature, which describes in detail the way in which they shall be managed. In some cases, the towns are to choose "fish committees," who shall capture the fish, personally or by proxy; in other cases the privilege of taking them is to be sold at auction to the highest bidder, but in either case it is generally provided that citizens of the town shall be allowed to buy limited quantities of fish at a fixed price, and certain poor people are supplied gratis. If there is a surplus the committee or the lessee can dispose of them as they see fit. These town fisheries in most cases nominally include also salmon and shad, but on the small rivers both of those species have long since been practically exterminated.

UTILIZATION.—Alewives are used as bait for deep-sea fisheries to a small extent, but by far the greater part are used as food for man. The prevailing methods of curing are, first to salt and smoke them, second, to pickle and afterwards pack them in barrels. The former method is generally regarded as more profitable for fishermen who are able to retail the products of their fisheries, and is therefore most employed by them, each man having a little smoke-house of his own. Where great quantities are taken by one party, as by the lessees of the Damariscotta fisheries, they are barreled and sent to the wholesale markets. On the Kennebec, about seven-eighths of the alewives caught are smoked and consumed locally, and smoking has been the prevalent mode of curing for many years. On the Penobscot, at Bucksport, previous to 1830, the most of the alewives were pickled, but the practice of smoking came into general use shortly after that date and has for many years entirely supplanted pickling.

For smoking, alewives are first prepared by salting lightly in a large tub, without scaling or any other dressing; they are treated with about 8 quarts of salt to a barrel of fish. Some add 2 ounces of saltpeter. In three days the fish are sufficiently "struck," and they are then, after rinsing in clean water, impaled on straight sticks of split cedar or spruce, which are thrust through the gills, ten on a stick (formerly twelve), and hung up in the smoke-house. On the ground beneath

them a fire is made, generally of hard wood and smothered with saw-dust. After four to six days in the smoke-house, during which they may be actually exposed to smoke less than half the time, they are ready for sale. This is an outline of the practice of a Kennebec fisherman. The practice of individuals varies not a little, and the finished product is of many grades of excellence or inferiority. They are most palatable when lightly salted and smoked, but in that condition cannot be kept long. Selling at 40 to 80 cents per 100 and retailing at a cent apiece, they form a cheap and toothsome article of food, much sought for in all parts of the State.

For barreling, alewives are "struck" with 1½ bushels of salt to the barrel, without dressing or scaling, and after lying from four to six days they are packed closely in barrels with half a bushel or more of new salt per barrel, and filled up with sweet and strong pickle. Alewives keep better in pickle than other fish, and are therefore exceptionally well fitted for exportation to warm climates. Great quantities of them are exported to the West Indies and other warm countries. The practice of packing them without pickle has prevailed at times in some localities.

THE SMELT (OSMERUS MORDAX).

NATURAL HISTORY.—The smelt ascends the rivers for the double purpose of feeding and of depositing its spawn. On the eastern part of the coast it may be caught with hook and line in the harbors all through the summer season; farther west it is not to be caught until September or October, being probably a short distance off shore. In October it begins its advance all along the line, and as soon as the law permits (now October 1) the fishermen begin to set their fykes and bag-nets and ply their seines in the mouths of the rivers. With the first strong ice in December the fish are found already present in the fresh tidal parts of the rivers, and during the whole of the winter there are smelts to be found everywhere from the mouths of the rivers to the head of the tide. The smelt is a ravenous feeder at all times of the year except about the spawning time. At Robbinston it begins to take the hook about May 1, and continues to bite through the summer, autumn, and winter.

The spawning time is in April and May, a week or two after the ice leaves the river. Phenomena observed indicate that it is extended through the greater part of both months. In several brooks in Bucksport the smelt spawns from May 20 to 25, but in certain brooks in Dear Isle just a month earlier. The eggs are adhesive, and stones, sticks, weeds, and any rubbish furnish receptacles. Sometimes they are deposited on the stony or weedy bottom of a tidal river, either in fresh or brackish water, and sometimes in the pure, fresh water of small brooks.

Owing probably to over-fishing, the smelts now caught are in most rivers much smaller than formerly. Those of the Saco are nearly or quite the largest in the State; they are said to weigh from 2 pounds to 2½ pounds per dozen (five or six fish to the pound). Those taken in New Meadows River in weirs and seines count fourteen to the pound; those taken by hook in the Kennebec at Gardiner sixteen to the pound. The smallest marketed (but not the smallest caught) from Bucksport are adults 6 inches long and weigh about 1 ounce; among the larger specimens are some weighing 4 ounces and measuring 8 to 9 inches in length.

MODES OF CAPTURE.—The modes of catching smelts now or formerly employed in Maine comprehend the use of weirs, seines, bag-nets, gill-nets, dip-nets, and hook and line. All of these modes are in use at the present time except gill-nets.

Weirs.—The weirs used for smelts are generally "half-tide" weirs. They are built sometimes in a narrow cove, which they completely span, and sometimes at the head of a broad and shallow bay, where they receive the form of a tunnel with the apex pointing outward. At high water the smelts pass freely over them into the bay or river, but on the ebb-tide are intercepted by the spread-

ing wings of the tunnel and fall into the pounds at the apex. Such weirs are employed in the Kennebec, Sheepscot, Piscataqua, and Casco Bay. They are generally erected in early autumn and kept in operation until broken down by the ice of winter.

Seines.—Seines are but little used, and only in the vicinity of Brunswick and Harpswell. They are small affairs, 15 to 20 fathoms long, and of 1-inch mesh, and are used in narrow creeks and coves from October to December, and occasionally in the spring.

Bag-nets.—The bag-net fishery for smelts is of considerable importance, a larger aggregate quantity being caught this way than by any other method except hook and line. Its principal seats are the Kennebec and Penobscot Rivers, but it is also carried on in the Wescongus, Harrington, and Tunk Rivers to a small extent.

The bag-nets used in different localities vary some, but those of the Penobscot may be taken as the type, and will be described in detail. These nets are plain bags, knit of strong cotton twine, of 1⅛-inch mesh. The mouth of the net is rectangular, 25 or 30 feet wide and from 12 to 18 feet deep. The "trail" or length of the bag is 30 or 35 feet. The bottom and top commonly taper toward the trail to half their width at the mouth, and the sides taper to a point. The fixtures to which this net is attached and the mode of attachment vary according to circumstances, the fishing being pursued sometimes in the open water, sometimes in the spaces between the piers of a bridge, and sometimes beneath the ice.

For an open-water fishery the bag-net is hung upon a rectangular wooden frame a little larger than the mouth of the net, to the corners of which are attached four guys, running to a slightly buoyant log of wood, which, in its turn, is chained to a heavy stone, dropped to the bottom of the river. Thus anchored the net swings freely in the tide, but with a current of moderate strength it is pressed down until the bottom of the frame rests on the bed of the river. The attachment of the net to the frame is by means of large rings, which slide freely up and down on the upright sides of the frame. Ropes passing over pulleys at the top and bottom serve to open the net and draw it down to its place in the frame, or to close its mouth and draw it up, while the same lines running to the surface and suspended by small buoys mark the place of the net, and enable the fisherman, working from his boat, to draw it up. In some districts this frame is called a "wrinkle."

If ice covers the fishing grounds a very different arrangement must be resorted to. A narrow hole, as long as the net is wide, is cut in the ice at right angles with the current, and at either end of it is planted, upright, a stout pole something over 40 feet in length, running down 35 feet, more or less, into the water, and secured in position by guys attached to both top and bottom, and anchored in the ice. Ropes running through blocks draw the net down to its place at the bottom of the poles, or draw it up through the ice to be emptied of its fish. The whole arrangement rises and falls with the tide. The net is therefore, when set, at a constant depth beneath the ice, and at a varying height above the bottom of the river. Nearly the same arrangement is employed at a bridge as at Bucksport, but in this case the fixtures are attached to the bridge, and the net is at all times, when fishing, close to the bottom.

The bag-net, whether used on a frame in open water, beneath the ice, or at a bridge, is drawn entirely out of the water to secure the fish. It is made fast to the standing fixtures securely, but so as to be easily cast off and taken ashore. The fishing is done both by day and night, but, in general, the night tides are by far the most productive. Flood tide is at Verona bridge much more productive than ebb-tide, but at Sparks's Point, 3 miles below, a frame fishery finds the opposite to be true. Spring tides are more favorable than neap tides.

Fykes.—Fykes are double bag-nets, the large open-mouthed net in front leading by a narrow opening at its apex into a smaller one, termed the "pocket," from which, as from a weir, fish escape with difficulty. The fish are taken out by drawing up the "pocket," through a separate hole in the ice, and unlacing an opening at the bottom, the main part of the fyke remaining under water for weeks or months. The fyke has been used in various parts of the State, but does not appear to have given entire satisfaction. There is complaint of its being more difficult to clear of rubbish, anchor ice, &c., than the plain bag-net, which has in some cases superseded it.

The various forms of bag-nets have been in use on the Kennebec since 1852, and in the Penobscot for a shorter period.

Gill-nets.—The only form of gill-net known to have been used for the capture of smelts in Maine was in use in the Kennebec before the introduction of bag-nets. It was a small affair, stretched on a frame about 6 feet square, and set through a hole in the ice. A great many of these were used in small tributaries of Merrymeeting Bay, and were quite effective while smelts were plenty and large.

Dip-nets.—Dip-nets are only used in the spring, in brooks where the smelts spawn, or at points where their ascent of the rivers is obstructed. The product of this fishery is of small amount, and contributes very little to the supply of the markets.

Hook and line.—The hook and line fishery has always been the most important mode of taking smelts, whether we regard the gross product or the number of persons employed, though when it is brought into direct competition with bag-net fishing on the same ground, it is found less productive. Smelts can be taken with hook and line during the autumn months, but it is not until winter that any considerable numbers are thus taken. As soon as the ice forms on brackish and fresh tidal waters the line fishermen begin to ply their vocation. Through December and January the work is generally brisk, but in February the catch begins to slacken, and very few fishermen continue their efforts in March. Smelts can be caught through the ice as far up the fresh rivers as they ascend, but the most productive fisheries are located on brackish estuaries and bays, as Nequasset Bay in Woolwich, Damariscotta Bay, the Medomak River in Waldoborough, and Bagaduce River in Brooksville.

The outfit of a hook fisherman for smelts formerly embraced only a hook and line, an ax or ice-chisel for cutting holes, and perhaps a pail for bait and a few boughs to stand on. A thrifty fisherman would, after finding a good location, protect himself from the cold winds by means of a clump of evergreen bushes, and a progressive development in the direction of comfort produced finally the present smelt fisher's house with its dry board floor and stove.

In the Damariscotta fishery (which has been selected for description as representing the prevailing style), the smelt houses were at first built of heavy boards, then with wooden frames and walls of clapboards, and finally a few years ago other coverings gave place generally to cloth. They are commonly 5 feet long and 4 wide, cost about $5 all complete, with stove, and can be easily moved about on a hand-sled. Each house is occupied by one man, who uses two lines with one hook, or sometimes two, on each line. The lines are of cotton, either plain or laid in oil, and Kinsey hooks, Nos. 13 to 16 are used. For bait they employ generally pieces of marsh minnows, which are caught in the fall and kept alive until used. When minnows cannot be had they cut up smelts for bait. In old times the fishing was always in shoal water, but it is now found that the smelts can be taken in water of any depth from 2 to 20 feet and on either ebb or flood tide. The fishermen do not agree as to what part of the bay is best nor do the smelts appear to be constant in frequenting any particular spots; in searching for them the houses move about a great deal, often changing location several times a day.

In other localities experience and practice vary a little from those of Damariscotta. At Woolwich they use clam-worms for bait; at Waldoborough, clam-worms, smelts, eels, fresh beef, and minnows. At Saco there are more ambitious houses, 6 feet long and nearly as wide, with walls, 5 feet 9 inches high, and costing $17 to $20; in such a house a man uses six lines made fast to a bar overhead and dropping through a hole 6 feet long; fishing mainly at night, he places a kerosene lamp with a white paper shade, at each end of the hole to attract the smelts, and in one corner stands a coal stove.

The hook fishery is pursued by people of many different callings, who find a lack of employment in the winter—farmers, laborers, and mechanics of various trades, comparatively few of whom are engaged in fishing at other seasons. Some of them are strictly amateurs and catch merely for their own tables; many others dispose of their surplus in the local markets, but a very large number follow the occupation steadily and send their fish to distant markets, mainly Boston and New York. Altogether there is no branch of the river fisheries that contributes so much to the comfort and well-being of the local population as this.

MARKETING SMELTS.—Smelts are all marketed and consumed fresh. It is the common practice to freeze them, and then forward to market in boxes and barrels. It has been recently discovered that a partial freezing, leaving the fish flexible, is a better preparation for transportation than freezing them stiff; besides, a much larger quantity of the flexible smelts can be put into a barrel or a box of given dimensions. It is also a recent discovery that without freezing smelts can be shipped to Boston or New York in a tight fish barrel filled with iced water, a large lump of ice being placed in the middle. This is a very satisfactory method to the dealers, the fish opening in fine condition with a very fresh appearance and meeting with a ready sale; but it involves the transport of a great deal of water and ice, and for that reason is not much employed except in time of warm weather when freezing cannot be effected, and dry packing is not safe.

Probably the quantity of smelts consumed in Maine does not exceed 10 per cent. of the total catch. Of the remainder nearly all find a market in Boston and New York, the latter taking more than half. Thus, of 254,000 pounds shipped to those two points from Bath, Woolwich, Waldoborough, Warren, and Thomaston, 138,000 pounds went to New York, and 116,000 pounds to Boston.

STRIPED BASS (ROCCUS LINEATUS.)

NATURAL HISTORY.—The data for a complete account of the natural history of this species do not exist, and as there is a special lack of knowledge of its life in Maine rivers, the present notice will properly be very brief. The bass is found in substantially all the brackish waters of the State, and ascend the rivers a short distance at various seasons of the year. On the Kennebec it used to ascend the main river as far as Waterville, and the Sebasticook a short distance above its mouth; but since the building of the dam at Augusta that place has been the limit of its migration. The principal run is in the month of June, at which time it feeds greedily, apparently ascending the rivers for that purpose. It continues to feed in weedy coves and bays till November. In the winter great numbers of young, 2 or 3 inches long, are found in the rivers, and many of them fall into the bag-nets and are captured along with smelts and tom-cods. Larger individuals appear in many cases to retreat to quiet bays and coves of fresh water in the lower parts of the rivers, and pass the winter in a state of semi-hibernation.

There are some facts that favor the view that bass spawn in the rivers. For instance, a male with ripe milt has been observed on the Kennebec as far up as Augusta about the 1st of July. The fishermen of Merrymeeting Bay think that they spawn in the summer, because they are to be found

there in June full of spawn, which is not, however, found ripe during the shad-fishing season, which extends sometimes into July; while in the fall they contain no spawn unless in the very first stages of growth. Bass sometimes attain a great size in Maine, though they do not appear to average so large as farther south. The largest reported, weighing 100½ pounds, is said to have been taken some years ago in Middle Bay, an arm of Casco Bay, and specimens of over 50 pounds in weight are not very rare,* yet the average weight of all caught is probably less than 5 pounds. Those caught in the weirs will hardly exceed 2 pounds. Those taken in gill-nets under the ice at Sheepscot Bridge weigh from 3 to 12 pounds, rarely 30 to 40.

MODES OF CAPTURE.—Bass of marketable size are caught in the spring weirs, but to no great extent at the present time. The fishermen say that they are difficult to catch, being cunning enough to find their way out of the weirs. Four methods appear to have been specially employed for their capture: (1) Dip-nets, set under the ice. (2) Stop-nets, set in summer and autumn across the mouths of coves. (3) Gill-nets. (4) Hook and line.

Dip-nets.—These were used many years ago in the mouth of Eastern River, Dresden, specially for bass. They were plain bags, 7 or 8 feet wide at the mouth, hung on a semicircular bow at the end of a large pole which was held in the hand, and were operated by pushing down through holes in the ice and resting on the bottom. As soon as a bass struck the net it was immediately pulled out. This fishing was done in the edge of the evening on the "dark" of the moon. As many as sixty nets were counted at one time fishing at that place. This fishery was discontinued in consequence of scarcity of bass, about 1850. In Winnegance Creek, just below the city of Bath, one winter a man who was spearing eels in the mud took, by accident, a bass. Nets were immediately brought into use and "tons and tons" of bass taken out.†

Stop-nets.—The "stopping" of coves is a modern method. At high water a stout net, generally 12 feet deep and of 2½ to 3 inches mesh is stretched at high-water directly across the mouth of a cove, and kept in place until low water. Bass doubtless frequent such places for the purpose of feeding. They move very quietly and close to the bottom, and their presence is not easily ascertained till the tide has left them. This method of fishing, therefore, proceeds entirely at random as to the presence of the prey. Sometimes it is entirely unsuccessful, and at other times great hauls are made. It was first practiced‡ by Thomas Spinney and John Marr, of Georgetown, who made their first attempt with salmon nets at Preble's flats, opposite Bath, somewhere between 1844 and 1848. On that occasion they took out 11,000 pounds of bass, and during that year shipped 52,000 pounds to New York. Another instance of a successful haul occurred at Butler's Cove, an arm of Merrymeeting Bay, one autumn about 1850, on which occasion fifteen cart-loads of bass were secured. Eighty-five barrels of them were sent to New Orleans and sold for $8 per barrel. This method of fishing is employed irregularly, and no one appears to have been engaged in it in 1880.

Gill-nets.—These are used, among other places, in Sheepscot and Dyer's Rivers, above Sheepscot Bridge, in the winter, under the ice. The nets used at this place are commonly 35 feet long, 12 to 15 feet deep, and of a 4-inch mesh, furnished with ordinary floats and very heavy sinkers, costing, complete, about $4. In operating, a narrow opening is cut through the ice across the channel (whose width is about equal to the length of the nets, though quite deep), and the nets

*Mr. M. B. Spinney, of Georgetown, who has made a business of fishing for bass with stop-nets, says that he once took a bass of 80 pounds, and another, which, after dressing, weighed 62½ pounds, equivalent, he thinks to over 90 pounds live weight, and of specimens that exceeded 50 pounds he has taken hundreds. Mr. S. is also the authority for the capture of the bass weighing 100½ pounds.

†Statement of John Brown.

‡Statement of M. B. Spinney.

set in without any frame. The tide is so strong that the nets can only be drawn out when it is rather slack; so they are drawn only at high and low water, and kept in place all the rest of the time. This method has also been in use at some points on the Kennebec River, and indeed is probably a very ancient method.

Hook and line.—The hook and line fishing for bass is practiced as a pastime at a few points, especially near obstructions at the head of the tide, as at Augusta, on the Kennebec.

MODES OF CURING.—The only mode of curing bass employed in Maine is salting in barrels. Some parties once dried a large lot of them in Casco Bay, but they are said to have been too fat to keep, and all were lost. With the exception of an occasional large haul all the bass are now marketed fresh.

HISTORICAL NOTES.—Bass were undoubtedly quite plenty in early times in most of the rivers west of the Penobscot. In the latter river the old fishermen speak of them as having been "plenty," but the degree of abundance was by no means equal to that existing in the Kennebec, and at no time has this species been marketed in any considerable numbers from the Penobscot or any river farther east. In the west they were early subjects of legislation, indicating not only that they were plenty enough to be thought worthy of attention, but also that there was an actual or apprehended diminution of their numbers. The preamble to an act of the New Hampshire legislature "to preserve the fish in Piscataqua River," recites that the fishing for bass and bluefish* in winter "hath almost destroyed the bass and bluefish in said river." In 1800 the legislature of Massachusetts passed an act "for the preservation of fish called bass in Dunstan River in Scarborough, in the county of Cumberland." On the Kennebec at Abagadasset Point, as late as 1830, bass were so plenty that the fishermen were troubled to dispose of those taken in the weirs. A single weir has been known to take 1,000 pounds at one tide. There was no demand for them. Sometimes hired men would take them in pay. When plentiest they were given away. Mr. John Brown says that about the time of their first diminution he obtained a contract with General Millay, the keeper of the Bowdoinham town poor, to furnish 1,600 pounds of bass at three-quarters of a cent per pound, but the fish were not plenty that year and he caught only 800 pounds. The extent of the diminution is illustrated by comparing the above statement with the statistics representing the present condition of the bass fishery. The total catch of twenty-two weirs on and about Abagadasset Point in 1880 was but 3,510 pounds; the Kennebec River yielded a total of 12,760 pounds, and the entire State 26,760 pounds.

THE EEL (ANGUILLA ROSTRATA).

NATURAL HISTORY.—The common eel is found all along the coast of Maine and in all the rivers accessible from the sea, as well as in some fresh waters which would appear to be absolutely inaccessible in their present condition.† In waters communicating with the sea the young eels move up-stream in early summer to the fresh water of lakes and streams, where they feed and grow. At the beginning of this migration the young eels are very small. In the month of July they can be found 4 or 5 inches long climbing dams at the head of tide waters. They are able to crawl many feet up a perpendicular wall down which the thinnest sheet of water is trickling, and it is probable that they pass many dams that are insuperable to all other fishes, and thus reach some waters very remote from the sea. The adult females, or a portion of them, are found

* The term "bluefish" must refer to some other than the marine species now known by that name.

† This is still debatable ground, some observers maintaining that all eels, however remote from the sea they may be found, reached their abode by ascending the rivers.

descending the rivers to the sea in the autumn very large and full of spawn. In winter eels are found bedded in mud at the bottoms of rivers and bays in fresh, brackish, or wholly salt water. In some cases they leave the salt water in autumn and push up into fresh-water streams, even into very small brooks, and there pass the winter in the mud.

Observations made in other countries indicate the probability of these conclusions: that the female eel alone ascends the rivers, the males staying behind in the salt water; that the females when mature always go down to sea and pass out beyond the reach of observation, where they are joined by the males, and lay their eggs early in winter; that after spawning once the females die. Unlike the salmon, shad, and alewife, the eel is a predatory fish while in fresh water, greedily devouring all animal substances. At the beginning of their seaward migration, however, the females cease to eat.

METHODS OF CAPTURE.—Eels are taken with spears, in traps and pots set for the most part in tidal rivers, and in weirs built across the streams that they descend in the autumn.

Weirs.—An eel-weir has much the form of a smelt-weir, two wings running out from the opposite shores of the stream obliquely downward and converging to form a tunnel; at the apex is a long narrow spout leading into a box from which the eels cannot escape. Rough weirs are occasionally made of brush and stakes, but the most efficient have the wings constructed of sawed slats combined in racks, which, when in place, rest on a close piling, affording the eels not the slightest opening for escape, and effectually preventing their undermining the structure. The best specimen of an eel weir, and indeed the only systematically conducted fishery of the sort that has come under the writer's observation, is found on the Cobbosseecontee stream, at Gardiner, on the Kennebec. Mr. T. H. Spear, the proprietor, has extended his operations to the collection of young eels as they enter the river in summer and their transfer to the waters above.

Eel-traps.—An eel-trap, known only among the fishermen of the lower Kennebec, is a diminutive eel-weir, planted on the flats in a favorable position to intercept eels in their movements along the shores. They are generally set so as to make captures on the ebb tide. When the trap was first invented, about the year 1875, it was set with a view to taking eels as they descend in the spring, from their winter bedding places in the mud of fresh-water marshes on the small brooks near tide water, and the most of the traps are still constructed so as to take eels descending with the ebb tide; but experiment has demonstrated that they can be successfully caught with the arrangement reversed so as to take only those that are ascending the river; and it is probable that the fish that fall into the traps are merely working their way along the shore, either up or down, in search of food. A good eel-trap costs about $25.

Eel-pots and baskets.—Pots and baskets of various forms are much used in some districts. The most approved form of late is made from a barrel by substituting funnel-formed screens for the heads. Baited with fresh fish, free from taint, these are sunk to the bottom in favorable positions often alongside fish-weirs. The eels, probably scenting the bait, push their way in by the tunnel-formed entrance, but are unable to escape. This is a very old method of fishing.

Pots and traps are often used in conjunction by the same fishermen, as they are available at the same season. On the Kennebec they are used from May 10 to the last of September.

The spear.—The implement most widely known and used for the capture of eels is the spear. The form in common use in Maine consists of a spatula-formed center piece with three teeth on either side, each tooth having a single barb on the inner side. The teeth are of steel, about 8 inches long, slender, elastic, spreading at the tips about 8 inches. With this implement at the head of a long wooden pole the fisherman industriously prods the soft muddy bottom through a

hole in the ice, or sometimes from a boat. Each several thrust is made entirely at random, but experience guides to a choice of the proper kind of bottom and the topographical location and extent of the beds.

At Dresden, in the mouth of Eastern River, are some beds much resorted to now and for the last eighteen years. The water there is entirely fresh. The fishing is, as a rule, done on the channel banks, but sometimes quite out in the channel, so that at low tide the depth of water over the different parts of the beds may vary from 5 to 25 feet. Some observers are led to the conclusion that mud meeting in all respects the requirements of the eels occurs only in patches, and when they find one of these patches they will bed in it to whatever depth it may carry them. So the fishermen come armed with two spear poles, one of which is often 28 or 30 feet long.*

Another locality for eel-spearing is in Quohog Bay, in the town of Harpswell. Here in 1876 an eel-bed was discovered which is famous as being the most productive one ever known in that region. It lies in 13 feet of water at low tide, just outside the eel-grass zone, and extends over about 10 acres. When first discovered it was so densely inhabited by eels that a spear often brought up four or five at a time. This still continues to be more productive than any other bed in the vicinity, and yields about three-quarters of all the eels taken in Harpswell.† The time when the fishing can well be carried on is limited to about six hours at each low tide, and is practically confined to the tide occurring in the daytime and to the first two months after the ice forms. Later the labor of cutting through the thick ice becomes too great.†

There are doubtless many such beds yet to be discovered. The more thinly inhabited beds are well distributed all along the coast.

Marketing eels.—The eels taken in summer with pots and traps are for the most part packed whole ("round") with ice in barrels and shipped to New York. The demand is very lively during the first part of the season, and shippers receive about 6 cents a pound, free of freights and commissions. The product of the spear fisheries and of the fall weirs is, on the other hand, dressed before marketing, and brings about 7 cents per pound in New York. As the shipper has to pay freight and charges, and as 200 pounds live weight will not dress more than 140 pounds, it will be seen that the round eels, the product of pots and traps, give the best profits.

STURGEON (ACIPENSER STURIO).

NATURAL HISTORY.—The common sturgeon of the Atlantic rivers is the only species known to visit the rivers of Maine. It ascends the larger of them for the purpose of depositing its spawn, which it does in midsummer. Some intelligent observers think their natural spawning grounds are almost wholly above the flow of the tide. On the Kennebec it is believed that they were mainly between Augusta and Waterville, a view which is supported by the fact that the closing of the river by a dam at Augusta was followed by a great decrease in the number of sturgeon. Very little is known about the growth of the sturgeon in Maine. The earlier stages are rarely seen, except that a considerable number about 18 inches in length are caught in the smelt-nets of the Kennebec in winter; they are very slender and sharp-nosed, and are termed by the fishermen "pegging awls." The adults caught in the Kennebec average not far from 120 pounds in weight.

METHODS OF CATCHING.—Sturgeon ascending the rivers in company with shad, alewives, and salmon fall often into the weirs built for those species, and to fishermen who have not made arrangements for utilizing them they prove sometimes a very great nuisance. But the only means specially or regularly employed for taking them is the drift-net. Those now in use on the

* Statement of W. W. Walker.
† Statement of Stephen Kemp, of Harpswell.

Kennebec are of cotton (sometimes hemp) twine of 12-inch mesh (occasionally varied, but always between 10 and 13 inch), 25 to 30 meshes deep, 80 to 100 fathoms long, corked and leaded like any drift-net. These are set by night on the ebb tide from a large punt worked commonly by two men. The ordinary fishing grounds on the Kennebec extend from Bath to Richmond, but sturgeon can be and sometimes are caught as far up as Augusta.

UTILIZATION.—At the present time no portion of the sturgeon is saved but the clear flesh, which is cut from the trunk, packed in ice and sent to New York, where it is smoked for use. About half the fish is refuse, including the entrails, head, skin, and vertebral column. The preservation of the roe for the making of caviar, and the trying out of the oil with which the refuse abounds have been sometimes practiced in former years, but at present all but the clear flesh is thrown into the refuse heap and employed only for fertilizing the land.

HISTORICAL NOTES ON THE STURGEON FISHERY.—Sturgeon were apparently more highly esteemed in the early days of American history than now. They were specially mentioned in the original grant of the King of England to Ferdinando Gorges, conveying a large territory in the southwestern part of the State inclusive of the Kennebec River. In the early part of the eighteenth century there existed a flourishing sturgeon fishery in the province of Maine, which employed some years over twenty vessels, and was esteemed an important branch of industry. It does not appear, however, to have been prosecuted continuously. Very early in the present century a company of men came to the Kennebec, and, locating themselves on a small island near the outlet of Merrymeeting Bay, since known as "Sturgeon Island," engaged in the catching of sturgeon, which they soused, packed in kegs, and shipped to the West Indies, where they sold at $1 a keg.* This business was, however, suspended, for what reason is unknown, and though sturgeon were very abundant in the Kennebec during the early part of the present century, at least until about 1840, no attempt was made to utilize them except occasionally for home use, until 1849.

In 1849 a Mr. N. K. Lombard, representing a Boston firm, came down to the Kennebec, established himself at "Burnt Jacket," in the town of Woolwich, between Bath and Merrymeeting Bay, and undertook to put up the roe of sturgeon for caviar, and at the same time boil down the bodies for oil. A large number of fishermen engaged in the capture of sturgeon to sell to Lombard. The price paid was 25 to 50 cents apiece. The first year there were obtained 160 tons of sturgeon.† They yielded oil of fine quality, superior to sperm oil for illuminating purposes, in the opinion of the inhabitants of that vicinity, who have been accustomed to use it when attainable. The attempt to utilize the roe was at first unsuccessful. It was put into hogsheads, very lightly salted, and all spoiled. The next two years the roe was cured by salting heavier, drying, and laying it down with a little sturgeon oil, and was pronounced satisfactory. However, the business was discontinued after 1851. That year the sturgeon were quite scarce.

From this time there was a suspension of the sturgeon fishery until 1872, when some of the local fishermen of the Kennebec took it up again. In 1874 a crew of fishermen, headed by one John Mier, of New York, went into the business, catching and buying all they could, and shipping them to New York, where they proposed to smoke the flesh and utilize the roe for caviar and the sounds for glue. They aimed to catch the sturgeon early in the season, while the roe was yet black and hard, and to keep the fish alive until the proper time arrived for opening them. For the latter purpose they constructed a great pen, in which they at one time had seven hundred live sturgeon. After five years the sturgeon again became scarce, and the business was relinquished

* Statement of John Brown.

† Statement of Jos. Partridge, of Woolwich.

to local fishermen, who still continue to ship the flesh to New York, but throw away all other parts. In 1880, the least successful season in recent times, 12 fishermen were engaged in the business on the Kennebec, and the total catch was about 250 sturgeon, producing about 12,500 pounds of flesh, which sold in New York at 7 cents and returned the fishermen about 5 cents per pound.

4. DESCRIPTIVE AND HISTORICAL NOTES ON LOCAL FISHERIES.

SAINT CROIX RIVER.—The Saint Croix is remarkable, even among the rivers of Maine, for the great extent of the lake surface among its tributaries. On the best maps are represented 61 lakes, of which the smallest has an area of three-quarters of a square mile and the largest of 27 square miles. Their aggregate area is about 150 square miles, which is about 15 per cent. of the entire basin of the river. These lakes afforded breeding ground for great numbers of alewives, and, in the main river and its branches, here the salmon and there the shad found their favorite haunts. The exact limit of the upward migration of all these fishes is very naturally unknown with any degree of exactness, the entire upper portions of the basin being a wilderness till long after the occupation of the lower banks and the erection of artificial obstructions; but the fact of their existence in great numbers in the river shows that they must all have passed the only serious obstacle to their ascent, the natural fall at Salmon Falls near the head of the tide, and found their breeding grounds in the upper waters.

The best accessible testimony as to the former condition of these fisheries is found in Perley's "Report on the Fisheries of the Bay of Fundy."* The testimony there adduced may be thus summarized: From the first settlement of the country till 1825 there was annually a great abundance of salmon, shad, and alewives. Vessels from Rhode Island, of 100 to 150 tons burthen, followed the fishing business on the river and were never known to leave without full cargoes. There were also several seines belonging to the inhabitants, which were worked in the rideway of the river, the owners of which put up annually from 1,500 to 2,000 barrels of alewives for exportation, besides a sufficiency for country use. At the same time shad were caught in great numbers, often more than a hundred of them being caught in a small net in a single night. Salmon were so plenty that, according to testimony, a boy of fifteen has been known to take 500 in a single season with a dip-net, and a man has been known to take 118 salmon with a dip-net in a single day. The dipping place, both for salmon and shad, was at Salmon Falls. The prevailing price for salmon was 4 or 5 cents per pound. About 1825 the building of dams had reached such a stage as to seriously interfere with the ascent of fish, and they began rapidly to decline in numbers. In 1850 it was estimated that not over 200 salmon were taken. The decline in the alewife fishery had been equally great, and in the shad fishery still greater.

At the present time the condition of things is not much better than in 1850. The three dams at Calais and Baring, notwithstanding the construction of fishways, are very serious impediments, partly because they facilitate the work of poachers, and but few fish reach their spawning-grounds. Salmon are now taken in sufficient numbers to encourage the continuance of the fishery, and as incidental items there are taken a few alewives, a very few shad and bass, and small quantities of smelts and eels. The implements of capture are five weirs in the tidal portions and an uncertain number of drift and dip nets at Calais and Saint Stephen.

The weirs are similar to those in use on the Penobscot and Kennebec; two of them, those farthest up river, are half-tide weirs, and the others are "high weirs," with two pounds each, built of netting and stakes. They are all built in the spring and removed in the autumn. The half-

*Made by M. H. Perley, esq., to the Government Emigration Office, Saint John, New Brunswick, March 12, 1851.

tide weirs take smelts, alewives, a very few bass, sometimes a shad or a salmon, and miscellaneous fish, such as herring, bluebacks, &c., which are utilized to fertilize the land, but no shad or salmon were taken in them in 1880.

The high weirs, three in number, are built mainly for the capture of salmon, but take also alewives, smelts, shad, bass, herring, and a few cod and other sea fish. These weirs are all built in Calais; one of them just above Devil's Head, the other two near Red Beach. Farther down the river are weirs for the capture of herring, and in these, too, a very few salmon are taken.

The drift-nets are used solely for the capture of salmon, just below the lower dam in Calais and Saint Stephen. They are generally 75 feet long and 8 feet deep, with a 6-inch mesh. There are known to have been as many as seven of these nets in existence in 1880, but as they are often used covertly and illegally in immediate proximity to the dam, there is no means of ascertaining how many were in actual use at any time.

The dip nets are used for the capture of smelts and alewives about the falls, but all this fishing is exceedingly irregular, no one pursuing it as a regular industry, and all the product being consumed locally.

The salmon fishery has been in a low condition for many years, and the yield for the year 1880 ranks among the poorest of the last decade. The total number taken by all modes appears to have been 300, averaging in weight 12 pounds, and aggregating in value about $750.

The shad taken are mostly of the small size, termed "sea shad," but these are not taken in any considerable numbers. Sometimes a weir will take 500 of them in a season, and market them fresh along with alewives in Calais. Of the adults, to which the term "shad" is restricted among the fishermen, merely a few specimens are taken. The best weir sometimes takes twenty or thirty in a season, but in 1880 did not get half a dozen.

Of alewives about 115 barrels were taken in 1880, of which about 10 barrels were sold fresh, 30 barrels smoked, and 75 barrels salted. There are considerable quantities of bluebacks taken; they are not distinguished by the fishermen from alewives, but the above figures are believed to represent the numbers of true alewives.

Of bass (*Roccus lineatus*) very few are taken, about as many as of the river shad. One weighing 27 pounds was taken in one of the weirs in 1880.

Smelts are caught in the weirs in small numbers and in dip-nets at the Union dams in Calais. They are consumed locally, and the total quantity marketed probably does not exceed in value $150 yearly. The dip-net fishery is limited to two or three weeks in the spring. Smelts in plenty can be taken with the hook all through the summer in the lower part of the river.

Messrs. Lewis Wilson & Son have been engaged since 1853 in fishing in Calais just above Devil's Head, with a weir, always in the same spot and of the same form, without any perceptible interference from other weirs. Their experience may fairly be taken as indicating the relative abundance of the fishes that they catch. Their record of salmon has been very carefully kept, and shows that the years of the greatest abundance of that species were, in order, as follows: 1862, 1871, 1877, 1866, 1867, 1863, 1868; and the years of least abundance, in order, were 1850, 1874, 1869, 1853, 1865, 1864, 1857. Perhaps the most noteworthy fact disclosed by Mr. Wilson's record is that salmon run much later in the season on the Saint Croix than in the central and western rivers of the State. Fifty-two per cent. of the catch for the entire period was obtained later than the month of June, 21 per cent. was taken in August, and 3 per cent. in September. Similar generalizations can be made from the recent record of a weir at Red Beach, farther down the river, and the salmon are also known to run late in the Machias and East Machias Rivers. These are all in

marked contrast with the Penobscot River, where the principal catch is in the month of June, and where the number of salmon to be taken after the first ten days of July is rarely enough to warrant the fishermen in keeping their weirs in working condition.

PENMAQUAN RIVER.—This little tributary of Cobscook Bay drains a small territory in the towns of Charlotte and Baring, not exceeding 50 square miles in area, and affords an outlet to Pennaquan Lake and several smaller bodies of water. It is naturally well adapted to the growth of alewives, which formerly abounded in it, and tradition also says that there were once a good many salmon here. But very far back in the history of the country dams were built without suitable provision for the ascent of migratory fish, and the usual result followed. The salmon have entirely disappeared and very few alewives remain.

DENNY'S RIVER.—This is the first considerable stream west of the Pennaquan, and is the principal tributary of Cobscook Bay. It drains a basin of about 150 square miles, including two considerable lakes, Meddybemps and Cathance. The character of both the Denny's and its principal branch, the Cathance, is favorable for the breeding of salmon, and alewives find a breeding ground of great extent in Meddybemps Lake. Both of these species are known to have abounded in the river anciently, and tradition says that shad, too, frequented it. The shad disappeared early, but the salmon and alewives continued to ascend the river until 1845. Since the first settlement of the country there has been a dam at Dennysville, near the mouth of the river, but fish were able to pass it. In 1846 another dam, quite impassable, was built a mile farther up the river. The effect of this was to nearly exterminate the alewives, and the salmon, though they continued to breed in the river below this dam, were reduced to very small numbers. In 1858 this dam was destroyed by a fire which consumed the mill, and fish were again admitted to the upper waters. The alewives were still shut out from Meddybemps Lake, but in 1863 a fishway was constructed there which admitted them to the lake.

After the reopening of the river the salmon increased but slowly, owing to their persistent persecution at the dams and the setting of gill-nets at the mouth of the river. The alewives, however, increased very satisfactorily; in 1865 the number taken was estimated at 2 barrels; in 1866 at 15 barrels, and in 1867 at 240 barrels (about 125,000 fish). Since then the passage of the river has been a second time obstructed by a difficult dam, and a falling off in the number of fish resulted. At present the alewives are increasing, and it is estimated that in 1880 there were taken about 75,000, of which 30,000 were pickled and shipped to New York, and the remainder mostly smoked and consumed at home. The only mode of fishing for alewives employed here is with the dip-net.

Salmon are taken occasionally by spear and dip-net at the dams, now and then with the hook, but mainly in set-nets at the mouth of the river in tide-water. In 1880 there were four of these nets in use, and the total number of salmon taken is estimated at 200.

Denny's River is noted as the only river in the United States where fly-fishing for salmon has been practiced. In 1867, and for some years previous, it was the resort of several gentlemen from Portland, who succeeded fairly well, and the sport has been continued down to the present time by residents of Dennysville.

COBSCOOK OR ORANGE RIVER.—This is a very small river, lying almost wholly in the town of Whiting. It was in primitive times inhabited by many salmon and alewives, and according to tradition by shad also. Near the head of the tide three insurmountable dams were built many years ago, utterly exterminating the salmon, and reducing the alewives so that the catch was barely a dozen a year. In 1861, and subsequent years, an effort was made to restore both alewives and salmon, but it was only partially successful and at present the river is entirely unproductive.

EAST MACHIAS RIVER.—Naturally well adapted to the growth of alewives, this river continues to produce more of them than any other river in Maine east of the Penobscot. A few salmon are taken and scattering specimens of shad. In the winter smelts and tom-cods are caught in small numbers.

The spring and summer fisheries are carried on mainly by means of dip-nets at the falls in East Machias village, a few are caught in the same manner at a point 2 miles farther up the river, and a very small catch is secured by a few weirs in the tide-way. In 1880 but two of these weirs were built.

The dip-net fishery employed regularly, the whole or part of the time during the fishing season, about forty persons, besides an indefinite number of men and boys who took part in it occasionally. *The site of this fishery is between the two dams that here cross the river, and just below the lower* one. The fishermen build platforms at convenient points along the river's edge, and swing their nets in the foaming rapids. The nets in use are very well made and efficient. The best of them *have steel bows 3½ feet in diameter, poles 10 to 17 feet long, and nets of fine twine 5 feet deep.* The East Machias alewives are of good size, 400 of them filling a barrel when salted and packed for market. Of the 399 barrels caught in 1880, there were salted, 234 barrels; smoked, 135 barrels; and used fresh, 30 barrels.

Salmon are not known to have ever been very abundant in this river, and at the present time but very few are taken. For many years past there has been no decided increase nor decrease, though many fluctuations. In 1880 just 35 were caught, all of them in dip-nets by the alewife fishermen. This was much below the average catch.

Smelts are taken by night in April and May for home use and local market in dip-nets, differing from the alewife nets only in having a smaller mesh. They rarely ascend as far as the dams, but are caught along shore farther down. The smelt fishing commonly lasts ten or fifteen days. The yield in 1885 was but 15 barrels, and they appear to be decreasing. Tom-cods are taken in the winter with dip-nets to the extent of 55 barrels a year. Shad yield only occasional specimens now, though within twenty-five years they have been plenty enough to be of some importance. Some are now taken in the herring weirs of Holmes Bay.

MACHIAS RIVER.—In its original condition the Machias abounded in salmon. It yielded also shad and alewives, though in less numbers than the East Machias, owing, perhaps, in part to a very difficult natural fall at the head of the tide, and in part, so far as alewives are concerned, to the comparatively smaller area of lakes on this river. The difficulties of the falls at the head of the tide were further increased by the erection of a dam by the earliest white occupants, probably not later than 1784, the date of the incorporation of the town of Machias. Shad and alewives could no longer ascend the river, but the alewives were maintained in the river for many years by transferring a large number from the lower to the upper side of the falls each year. Salmon continued to breed and be caught in the river, until other and impassable dams were built, when they too disappeared along with the shad and alewives. At the present time the river is almost utterly unproductive of fish, the entire catch not exceeding 2 barrels of alewives and 5 barrels of tom-cods.

CHANDLER'S RIVER.—This little river, draining about 50 square miles of territory, once yielded, tradition says, salmon, shad, alewives, smelts, &c. Alewives and smelts are still taken in small numbers, as are also tom-cods, but salmon and shad have long since disappeared. Of alewives but five barrels yearly are taken by means of dip-nets. One bag-net is set for smelts in early winter, and some few dip-nets plied for them in spring, with an aggregate product of about 40 barrels yearly. A dip-net fishery for tom-cods in December yields about 200 bushels yearly.

WESCONGUS OR PLEASANT RIVER.—The drainage basin of the Wescongus measures about 110 square miles, the greater part of which is, like the basins of all the rivers thus far mentioned, covered with forest. The country about its mouth has been occupied by civilized people for more than a century, and is at present organized in two towns, Addison and Columbia Falls. The latter contains the most important village, which is located at the head of the tide, and was founded as early as 1765. At this village were found facilities for the building of mills for the sawing of lumber, which engaged the attention of the first settlers.

Salmon, tradition says, were once very abundant in this river, and notwithstanding the serious impediments placed in their way by the dams, continued to struggle up to their breeding grounds for many years after the settlement, and even at the present day are not utterly exterminated, a very few being yearly taken. About 1820 it was possible for a man to take a dozen in a day with a dip-net, which was the ordinary mode of capture, though gill-nets were sometimes used. In 1880 but a single one is known to have been caught. Salmon used to appear at Columbia Falls rarely earlier than June 1, but from that date they continued to ascend the river till January.* They ranged in weight from 6 to 18 pounds, the latter size being more common than the former; 7 and 8 pound fish were common. Their ascent of the main river is believed to have been stopped by an insurmountable natural fall 6 miles above Columbia Falls, and they are said to have spawned in a fine, gravelly tributary called "Lower Little River."

Alewives were pretty plenty sixty years ago, and were then of good size, whereas they are now small. Though they have not been able to surmount the dams at Columbia Falls for many years, they still come there yearly, about the middle or last of June (say two weeks later than at East Machias), and about 30 barrels yearly are dipped and smoked.

Shad are taken to a very limited extent in the three weirs built in the river and occasionally in drift-nets, of which several are owned in Addison, but none regularly used. They do not appear to have been plenty in the river within the memory of old inhabitants.

A very few eels are taken with spears. Tom-cods are caught with the smelts in very small numbers, but rarely sent to market. No sturgeon or bass are caught.

The most important place among the fishes of this river is now held by the smelt. About 15 tons of them are taken in weirs and bag-nets in Addison, 25 bushels are dipped at Columbia Falls in the spring, and perhaps an equal quantity in the brooks all up and down the river.

The weirs, which were introduced about 1872 or 1873, are all built of stakes and brush, standing with their tops 3 or 4 feet below high-water mark, the tide flowing over them. They are in the form of the letter L, the long arm running straight ashore and the short arm pointing up river; at the angle is a small pound constructed of wooden pickets. There were 3 of these built in the census year, all below Addison village.

The smelt-nets are in part plain bags, such as are used farther west, but most of them are fykes. They are set by attaching them to poles, which are planted through the ice into the mud in a location where the water is 8 feet deep at low tide. The nets are set both on the flood and ebb tide, and hauled at both high and low water. Fishing begins as soon as the ice will bear, which is generally about December 10 or 15, and continues till near April 1, the limit fixed by law. The first attempt at bag-net fishing was made by H. E. Willard, of Portland, in 1868. For the last eight years it has been carried on continuously. In the early years of the fishery smelts were plentier than now, prices were higher, and great returns were sometimes realized; in one instance, $58 for a single barrel of smelts. They are now marketed in Boston and New York, about two-

* Statement of Gowen Wilson, of Columbia Falls.

thirds of them in the latter city. They are uncommonly large. Some of the fishermen say they will average 6 or 7 to the pound, and that the largest will weigh 7 to 9 ounces; but it will not do to accept these figures without question.

HARRINGTON RIVER.—This is a tidal estuary lying wholly in the town of Harrington, and fed by a single fresh-water stream, a mere brook. The fisheries followed are: 1st, a summer fishery, with weirs for miscellaneous fish, in which a few alewives and shad are taken; 2d, a winter fishery for smelts, with bag-nets and weirs; 3d, a winter fishery for eels, with spears.

The summer fishery employed in 1880 but one man, who built a single weir.

The smelt fishery employed sixteen men, who set 18 bag-nets and built 4 weirs. They took 11½ tons of smelts, which were marketed, one-half in New York, three-eighths in Boston, and one-eighth in Philadelphia. The weir fishery for smelts has been carried on here for thirteen years, and the net fishery for ten years.

The eel fishery is not pursued persistently. The spears took about half a ton and a ton was obtained from the weirs. Some of them are salted, but most of them are sold fresh. They average, alive, half a pound in weight. The largest known weighed 4 pounds.

NARRAGUAGUS RIVER.—This river is larger than the three last mentioned, draining a territory of 215 square miles. In early times great numbers of salmon, shad, and alewives were taken here, but the dams at Cherryfield long ago destroyed them. Smelts have been taken in bag-nets in recent years, but this fishery also has been suspended, and the weir is this year quite unproductive.

TUNK RIVER.—Another very small stream, draining only 60 square miles of territory. There are some alewives, eels, and tom-cods caught and now and then a salmon, but the only fishes taken in numbers enough to be of any importance are smelts, which are fished for with weirs and bag-nets. There was but one weir built in 1879–'80, but 10 nets were in use, giving employment to nine men. The nets are plain bags, and are set in a line up and down the narrow channel, but, in obedience to local custom, never across it. The total catch was 4⅘ tons of smelts.

WEST BAY (Gouldsborough).—This is not an established fishing ground, but in the winter of 1879–'80 two men fished here with a bag-net for smelts, and caught 3,000 pounds.

WEST GOULDSBOROUGH.—Here is a fishery for alewives in the stream, which forms the outlet of Jones Pond, which is held as private property and claimed to be originally and always an artificial fishery. One Colonel Jones, one of the early settlers and proprietor of the mills at this place, about 1794 got some alewives from Mount Desert and put them into the mill-pond, thus establishing the brood in the stream. From that time down to the present it has been maintained wholly by carrying up and turning into the pond a few of the alewives caught. It has been the ordinary practice to carry up a basketful (one-third of a bushel) for each barrel killed. When the father of the present proprietors was in possession, they once caught a great quantity, estimated at over 200 barrels, but during the past twenty years the catch has ranged from 40 to 100 barrels, and in 1880 was as low as 30 barrels. They are all smoked and marketed locally.

SULLIVAN RIVER.—Some of the tributaries of this river have in former times supported alewife fisheries, as attested by tradition and by the record of legislation. In 1831 the legislature passed an act to regulate the alewife fishery in the town of Franklin, and in 1833 it passed another with reference to the town of Sullivan; but all these fisheries suffered the common fate—extinction by dams. In the expansion of the river known as Hog Bay smelt fisheries on a small scale have been carried on occasionally, but not regularly, and eel fisheries of some local importance exist at the east end of the bay in Donnel's Stream. The entire yield for the census year amounted to but 4,000 pounds of smelts and 5,000 pounds of eels.

MOUNT DESERT ISLAND.—Several ponds on this island formerly afforded breeding ground for alewives, but they are now almost extinct and afford no statistics. In 1821, and again in 1828, these fisheries were thought worthy of legislative protection.

UNION RIVER.—No river fisheries now exist here, though formerly salmon, shad, and alewives abounded. Especially good facilities are found at Ellsworth for the erection of dams, and they were improved at a very early date. A settlement was made here before the close of the last century and the corporate existence of the town of Ellsworth dates from the year 1800. In 1815, 1816, and 1823 the legislature passed acts regulating the fishery, but they were not sufficient to keep it alive many years.

In Patten's Stream, a tributary of the lower part of Union River, alewives have continued until the present time, but, owing to the obstructions offered by the dams, in numbers too small to afford statistics. Smelts, too, are caught, but in very small numbers.

BLUEHILL.—Here was formerly an alewife fishery, which was the subject of legislation in 1816, but it has long since been extinct.

PENOBSCOT RIVER.—The Penobscot is the largest river of Maine; its basin has an area of 8,200 square miles, extending almost entirely across the central portion of the State, a distance of 130 miles, and thence narrowing up rapidly as it approaches the sea-coast, where it is limited to the bed of its estuary. Thus it happens that though in its lower course it traverses a well-populated country, yet about half its basin, its entire upper portion, is covered by the original forest, where are neither tilled fields nor manufactories to foul its waters, nor lofty dams to limit the range of the salmon. In its western and southern portions the Penobscot Valley embraces several hilly and even mountainous districts, but, taken as a whole, it is much flatter than any of the river valleys to the westward of it. The elevations are very inconsiderable, and the rivers for the most part rather sluggish. The headwaters of the main branch are in the highlands on the western border of the State, from 1,600 to 2,000 feet above the sea, and about 300 miles from it by the river's course. But the river-bed falls off rapidly, and three-quarters of the descent to the sea is accomplished in half the distance. At Mattawamkeag, about 80 miles from the sea, the elevation of the river is but 190 feet. A descent of 98 feet is distributed over the 45 miles intervening between Mattawamkeag and Oldtown, and the remaining 92 feet fall is accomplished in the short distance of 15 miles between Oldtown and Bangor, where the river attains tide-level, though still 30 miles above the mouth of the river as fixed by the charts, but near 60 miles from the open sea. At the head of the tide and for some distance above, the river is 800 feet wide. At Mattawamkeag it is 500 feet wide after receiving the waters of the Mattawamkeag River, which has a width of 300 feet at its mouth.

The annual discharge of the Penobscot, exclusive of the tributaries below Bangor, is estimated at 278,800,000,000 cubic feet of water. The discharge at different seasons of the year is however, very unequal. In a heavy freshet 5,760,000 cubic feet of water pass Bangor per minute, while in time of drought the discharge at that point is but 146,000 cubic feet per minute, or about *one-fortieth as great.**

The principal branches of the Penobscot are: on the east side, the Passadumkeag, 35 miles long; the Mattawamkeag, 85 miles; the Mattagamon or East Branch, 63 miles; on the west side, the Piscataquis, 71 miles long. The smaller tributaries are very numerous, but, while nearly all of them contributed in olden times to production of fish, few remain open to them now except on the headwaters, which are beyond the reach of any but salmon. Of the lower tributaries there are

*For the most of the facts as to the elevations and volume of the Penobscot I am indebted to Wells's Water Power of Maine.

but two which are now accessible to anadromous fishes, the Bagaduce in Castine and Brooksville and the Eastern River in Orland, and even in these, especially in the former, there are serious hindrances to the ascent of the alewife, the only species that visits them.

Taken as a whole, the upper waters are well fitted for the propagation of salmon, as they abound in gravelly rapids, alternating with quiet stretches and deep pools, in which the salmon may bide their time, and to which they may retreat after spawning. The quiet waters of the main river and its principal branches are well adapted to the breeding of shad, and of the numerous lakes, whose number is 467 and aggregate area about 585 square miles, a sufficient number were naturally accessible to alewives to afford them very extensive breeding grounds. There are no insurmountable natural obstacles to the ascent of shad and alewives on the main river for 120 miles from the sea, and in some of the tributaries the way was open for nearly as great a distance, while salmon were able to push many miles farther up. At the present time both the main river and nearly all its branches are greatly obstructed by dams, which prevent the ascent of shad beyond tide-waters, which have extinguished the ancient broods of alewives that bred in the main river or tributaries above Bangor, and still shut them out from nearly all tributaries, and which have greatly hindered salmon in their ascent. All the principal dams on the main river are provided with fishways, which serve to keep the way open for salmon to their natural breeding grounds on the headwaters, but of neither alewives nor shad have new broods yet been established.

Present condition of the Penobscot fisheries.—The river fisheries of the Penobscot are now conducted for the capture of salmon, alewives, eels, and smelts. The few shad and bass taken are merely incidental to the salmon and alewife fishery, and the tom-cods to the smelt fishery.

Salmon.—Salmon are fished for with pound-nets or "traps" in the bay, with weirs in the upper bay and river as far up as Orrington, and with drift-nets at Bangor. The pound-net fishing is limited to the east shore of the island of Isleborough, and to the towns of Camden, Lincolnville, and Northport, on the western side of the bay. Nets of similar but simpler construction were formerly used on the eastern shore of the bay in the town of Brooksville, but since 1850 they have been abandoned.

The Isleborough salmon fishery is confined to the upper part of the eastern shore of the island, centering about Sabbath day Harbor; some berths formerly occupied with nets toward the south end have been abandoned as unprofitable. The entire western shore of the island is bare of nets, no profitable "berth" having been discovered. In 1880 there were 14 gangs of nets set *on the island, comprising a total of 17 traps, and the aggregate catch that year was 900 salmon.* As compared with 1873, this is a slight falling off in the catch, the number of gangs and traps remaining the same.

In Camden, Lincolnville, and Northport, salmon nets are scattered along the coast a distance of about 12 miles, but they are plentiest and most productive on the north side of Duck Trap Harbor, in the town of Lincolnville, where on a single mile of shore are nine gangs, of which one has four traps and four others have three traps each. In all there were in this district 27 gangs of nets, embracing 45 traps. The catch in 1884 was 1,398 salmon, being 163 less than in 1873.

Above Duck Trap Harbor there are no fisheries for a distance of 12 miles along the shore. At Moose Point, near Searsport, and at Castine, on the east shore of the bay, begin the weir fisheries, which extend, with occasional interruptions, as far up the river as Orrington. These weirs are built all on essentially the same plan, that of the ordinary floored weir, in some places exclusively for salmon and in others exclusively for alewives, but in most cases both species are taken in numbers enough to divide the interest of the fishermen between them.

In the district stretching from Moose Point eastward to Fort Point, including Searsport Harbor, Brigadier's Island, and Cape Gellison, the fishing is mainly for salmon. The shore of Cape Gellison trends about east-northeast, and is exposed to the full violence of southerly storms, which, together with the hard character of the bottom, necessitate greater care in building than in most districts. The use of frame foundations is common. The fishing is wholly with weirs, except two traps that were used in Searsport in 1880, but not regularly. The natural features of the district are favorable to the capture of salmon, and some of the most productive berths on the river are found here. Ninety per cent. of the money yield of these fisheries is derived from the salmon. In 1880 there were 20 weirs and 2 nets in this district, and their aggregate catch was 1,398 salmon.

From Fort Point north to Fort Knox, opposite Bucksport, weirs only are used, and 20 of them were built in 1880. The incline of the bottom being mostly steep, they are with one exception, built on separate hedges. Salmon are here also the most important fish caught, constituting in value 88 per cent. of the catch. The aggregate product of these 20 weirs in 1880 was 1,000 salmon.

On the eastern side of the bay salmon fishing now begins at Castine, where there has been a fairly productive fishery since early times near the light-house on Dice's Head. Between this point and Morse's Cove a few weirs are built, but they are not very productive. From Morse's Cove to the mouth of Eastern River the shore is thickly studded with long-hedged weirs, which are fairly productive of salmon, and take nearly twice as many alewives as the weirs on the opposite side of the bay. Within the mouth of Eastern River few salmon are taken, the yield falling off rapidly, while that of alewives increases as we ascend this river. The yield of 31 weirs and one net in the towns of Castine and Penobscot (the latter extending a mile up Eastern River) was 1,000 salmon.

Directly in the mouth of the Penobscot (or according to the pilot books, 8 miles above the mouth) is the island of Verona, formerly known as Orphan's Island or Whitmore's Island. This is one of the best salmon districts, but the salmon fishing is mainly confined to the south end, and to the west side, which is washed by the main channel. Weirs alone are employed. In 1880 there were thirty-four of them built, including one on Odom's ledge, and their aggregate yield of salmon was 2,053.

The town of Orland, including all of Easton River above the town of Penobscot, and all that part of Bucksport lying on the "Thoroughfare" (or channel that separates Verona from the mainland on its northeast side), *make up a district little interested in salmon, 37 weirs taking but 420.*

Above Fort Knox, on the west side, and Indian Point (formerly known as Mack's Point), on the east, are built 30 weirs, which are, however, far less productive than those below, their total catch being 1,044 salmon. The most of these weirs are located in the towns of Bucksport, on the east side, and Winterport, on the west. Above Winterport Village the yield rapidly diminishes, and 2 miles below Hampden Village we find the last weir.

Above Hampden there is no fishing done except by gill-nets, which are commonly employed in drifting, but are sometimes "set." Their operations in recent years are much limited by protective laws, which have driven them from their former grounds near the Treat's Falls dam. In 1880 there were eight fishermen thus employed in Bangor and Hampden, using 16 set-nets, but not constantly. At Veazie and Eddington there were six men, with 10 drift-nets, and their catch was 100 salmon. On the east branch of the Penobscot there were 10 set-nets used, and 686 salmon taken. This was an illegal fishery, was never followed to such an extent or so successfully before, and is not likely to be permitted in the future.

The totals of the Penobscot salmon-fishery are as follows: Number of weirs built 172, including the alewive weirs, of which all but 7 take some salmon, though 20 of them take so few that they are not considered of importance; traps (or pound-nets) set, 65; gill-nets in use, 36; number of salmon caught, 10,016.

Alewives.—The alewife fishery extends on the west side of the bay and river, from Moose Point to Hampden, and on the east shore from Castine to Orrington, but centers at Orland on Eastern River above the ordinary range of salmon. From early times the alewife fishery was far better on the east than on the west side of the bay and river, a fact which may be taken to indicate that the eastern tributaries originally contained more extensive or more favorable breeding grounds than those on the west. However this may have been when all the tributaries of the west side were accessible, it is certain that for a half a century the best and nearly all the breeding grounds have been on the east side. For nearly that length of time the lakes and ponds in Orland have been the principal breeding places of the alewife. At the present time the only other accessible pond is Walker's pond in Brooksville, which, however, has no appreciable effect on the fishery except in Castine Harbor and in Bagaduce River, where it is quite insignificant. Of the total of 730,000 alewives taken in 1880, only 95,000 (equal 13 per cent.) were taken on the west side.

The implements of the alewife fishery are the weirs, mainly the same engaged in the salmon fishery. Those built especially for alewives in Eastern River have no important peculiarities. There is also at Orland a small dip-net fishery, in which about thirty persons engage irregularly during the few days occupied by the alewives in ascending the dams.

The alewife fishery of the Penobscot may be summarized as follows:

District.	Number of weirs.	Number of dip-nets.	Number of alewives caught.
Castine to Penobscot	31	.....	65,000
Orland and Thoroughfare	37	20	302,000
Verona	34	.....	177,700
Searsport and Cape Gellison	20	.....	37,900
Fort Point to Fort Knox	26	.....	37,000
Above Indian Point	30	.....	21,000
Total	172	20	730,600

A few of the alewives are consumed fresh and a very small number salted (in 1880 only 17 barrels), 95 per cent. are smoked, and the most of these are disposed of in local markets.

Shad.—Nearly everything that can be said about shad in the Penobscot is of a historical character, and will be found on another page. At the present time the catch of shad is an incident, and a very unimportant one, of the weir-fishery for salmon and alewives. Only 800 were taken in 1880, as ascertained by careful inquiry.

Smelts.—The fishery for smelts ranks in importance next to that for salmon, the aggregate product being 266,875 pounds, valued at $14,579. It is carried on by means of weirs, bag-nets, and hook and line.

The weir fishery for smelts is confined to 4 small weirs, built in Eastern River and the Thoroughfare.

The bag-net fishery is the branch by which by far the greater part of the smelts are taken. It is confined to a few localities, mainly Eastern River and the Thoroughfare, the main river from Winterport to Mill Creek (South Orrington), and Marsh River, in Frankfort. The style of the

nets and the mode of setting them vary a little, to adapt them to the presence or absence of ice. In open water the nets are attached to frames which swing at heavy moorings. When the ice is strong enough to bear, the net is attached to a pair of long poles pushed down through a hole in the ice, with which the whole fixture rises and falls with the tide. In the Thoroughfare, and in the main river at Winterport, though the ice sometimes forms, it is too uncertain and unstable to be made use of to support the fixtures. But farther up the river, above Mill Creek, the ice-fixtures are in exclusive use. From Mill Creek down to Hurd's Brook fishing begins before the ice forms, and when it does form the nets are removed from the open-water fixtures and the ice-fixtures brought into use.

At the Bucksport and Verona bridge is a fishery of nets which are set between the piers of the bridge, substantially in the manner of the ice-nets of Orrington, but with the poles resting on the bottom.

In the winter of 1879–'80 there were 15 bag-nets in use in Orland; 31 in the Thoroughfare (including 8 at the bridge); 10 at Frankfort; 20 at Winterport Village; 13 at the "Bolan" ground some 2 miles above Winterport Village; 25 in Orrington.

The only dip-net fishing for smelts now existing on the Penobscot is at Orland, and that has long ago ceased to be of any importance.

Fishing for smelts with hook and line is occasionably tried in the main river near Mill Creek and at some other points, but is regularly employed only in Belfast Harbor and in Bagaduce River. In the latter locality it is followed by nearly one hundred persons. The fishing ground extends from Johnson's Narrows upward about 5 miles. The smelts are at hand in the fall, and in November the fishermen sometimes fish for them from rafts. But it is not until December that the river freezes up and the regular fishing begins, in little cloth huts on the ice. The first of the season only the ice above the toll-bridge at North Brooksville is strong enough to bear, but later operations extend down to the vicinity of the narrows. The fishing is followed at any time of tide, but only by day. The catch in 1880 amounted to about 61,000 pounds.

The total yield of all branches of the fishery for the year is estimated at 306,875 pounds of smelts.

Historical notes on the fisheries of Penobscot River.—Of the great immigration into Maine that set in from the other colonies, especially from Massachusetts, shortly after the middle of the eighteenth century, the Lower Penobscot Valley received its fair share. The early settlers found salmon, shad, and alewives very abundant, and engaged in their capture on a limited scale with such implements as they could command. Across the mouths of a few shallow coves they built, with stakes and brush, half-tide weirs to catch alewives, and with them took many shad. They knit nets with which they caught salmon, either by drifting in mid-stream or by setting the nets out from shore, secured by stakes and killocks. In the small streams and at convenient points in the larger ones they plied the dip-net. Notwithstanding the primitive character of their methods and apparatus, they took great quantities of fish. The local consumption was small; there were no good facilities for sending fish to the larger markets. The surplus salmon were mostly smoked, the shad pickled, and the alewives dry-salted and packed in barrels. These cured fish were forwarded to market by schooners bound for Boston, New York, or more southern ports. The demand for shad was limited, and they were less objects of pursuit than salmon and alewives; at first they were only taken in the cove-weirs built for alewives, and as accidental captures in the salmon nets, but after a while a better demand arose, and nets were knit and plied especially for them.

In the village stores salmon, shad, and alewives were bought and sold, and the merchants' books give us some information about prices.* The storekeeper paid for fresh salmon 2*d.* per pound, for salt salmon 2½*d.* and sold salt salmon at all seasons of the year for 4*d.* per pound. A half barrel of salmon is charged at £1 4*s.* Shad were bought in May and June at from 1½ to 3*d.* each, and sold in March at 6*d.* each. The selling price of a barrel of shad was from 30*s.* to 36*s.* Alewives are bought in May at 3*s.* per barrel, and retailed in December and February at £1 4*s.* The same merchant was retailing dry codfish at 4*d.* to 6*d.* per pound; salt pork at 10*d.*; salt beef at 4*d.*; flour at 6*d.*; corn at 8*s.* per bushel; sugar at 1*s.* per pound; sheeting at 2*s.* 6*d.* per yard. Thus the fisherman bartering his salmon for store goods would give 2 or 3 pounds of salmon for a pound of codfish; 5 pounds of salmon for a pound of pork; 2 pounds of salmon for a pound of beef; 3 pounds of salmon for a pound of flour; 48 pounds of salmon for a bushel of corn; 6 pounds of salmon for a pound of tea, and 15 pounds of salmon for a yard of sheeting. A comparison with the modern prices for these articles shows us that when salmon are sold by the fisherman at 12 cents per pound (and the price rarely goes lower) their purchasing power has increased, in exchange for codfish about 6 times; for pork, 5 times; for beef, 2 times; for flour, 10 times; for corn, 8 times; for sugar, 6 times; for sheeting, 22 times.

Shortly after the year 1800 weirs with three pounds, substantially of the modern form, were introduced. They were constructed wholly of stakes and brush, or in some cases partly of woven cedar mats. They had no floor but the bottom of the river, and were not extended beyond low-water mark because the fisherman must take his catch out with a dip-net. Such a weir in latter days would be a total failure, but in those times took a great abundance of fish. Their introduction is attributed by several authorities to one Hawley (or "Hollis") Emerson, of Phippsburg, in 1811 or 1815. The latter year he appears to have built such a weir at Treat's Point, on the west side of Marsh Bay, and it inclosed at one time such a mass of fish that its sides burst open and let them out. This form of weir came into immediate use, and in the river from Castine and Searsport to Orrington supplanted set-nets generally, though these have never passed wholly out of use. About the same time, or a few years later, floors were made for the fish-pounds, and one Halliday, said to be a Scotchman, and to have come from New Brunswick or Nova Scotia, introduced the use of netting for the walls of the fish-pound. To him is also by some attributed the introduction of floors. He built a weir on the west side of Orphan's Island (now Verona), and that was the first weir with "marlin" (netting), or with a floor, that was built in that neighborhood. The use of netting was, however, only gradually adopted, and we know that as late as 1829 some productive weirs were built at Bucksport without it. In Penobscot Bay, below Castine and Searsport, weirs were never adopted, but set-nets continued in use until comparatively recent times, when they were gradually transformed into the "traps" or pound-nets of the present day.

About the date of the introduction of three-pound weirs there sprung up a better demand for shad, which now became the leading fish for sale. Small vessels from Southern New England, some also from Portland, came and passed the fishing season in the Penobscot, buying salmon and shad to smoke and salt, and also buying the cured fish, not only of these species, but of alewives, salted or smoked. A considerable part of the catch found its way to market through their hands.

Fish were not continuously plenty; 1820 was a year of great scarcity, which continued several years after that date. In 1822 fish were scarce in Marsh Bay, but about the 1st of July, there was an extraordinary run of salmon which gave good fishing in Penobscot Bay, and as far up the

* Data from the books of Mr. Robert Treat, who kept a store in Bangor from 1786 to 1790.

river as the north end of Orphan's Island. The year 1820 is also noted as having been a year of complete failure of the shad fishery of the Kennebec. The recovery of the fisheries from this depression was, however, rapid and complete.

From 1823 to 1832 may be considered the palmy days of the Penobscot River fisheries Not that the fish were more plenty, for it is quite likely, especially in the case of alewives, that the closing of the tributaries was already beginning to tell on their numbers, but the gross quantity of fish taken and utilized and the profit received from them were probably greater than at any other time. Weirs were built through all the districts where they are now built, in some cases in greater and in others in less numbers than now, and there were flourishing drift-fisheries for both salmon and shad all up and down the river, 200 of them fishing between Mill Creek and Odom's Ledge, and a more extensive net-fishery for salmon on the shores and islands of the bay than now.

Bucksport became the most important center of the fish business. Dram Point flats, on the eastern side of Marsh Bay, became the site of a productive weir-fishery for alewives and shad. Weirs were built in imitation of Emerson's weir on the opposite side of the bay. In 1832 there were 17 weirs on these flats where in 1812 there was but 1 weir, and in 1873 but 3 weirs. Five firms were engaged in the capture and packing of the fish caught. Alewives were in less demand than shad, and it was sometimes necessary to get rid of them by giving them away or by turning them back into the river. When the number of fish exceeded the capacity of the packing houses, it was sometimes the rule to throw the alewives into the river direct from the weir. Dipping shad and alewives together from the pound, if the fisherman found that he had in his net mostly shad he would throw them into his boat, but if alewives predominated he would throw them overboard. The greater part of the fish caught were cured and packed, and sold to the small vessels engaged in the fish trade. The salmon were largely smoked, the shad all salted, the alewives dry-salted or smoked, the latter method having come into general favor. The following are quoted as prevailing prices: 5 to 7 cents per pound for salmon, $6 to $7 per barrel for shad, and $2.50 per barrel for salted alewives.

In 1832, however, this period of prosperity was rapidly approaching a disastrous end. Spurred on by the increasing demand for lumber and the profit to be derived from it, the operators were no longer contented with the mill-power derived from the tributary streams, but sought to bring the main Penobscot itself into their service. Up to 1830 there was no fixed impediment in the way of fish ascending the main river, but in that year a dam was built at Oldtown which seems to have seriously hindered the passage of shad and alewives, and in 1834 or 1835 there was another dam built at Veazie which for several years constituted an impassable barrier. By the gradual washing away of the left bank of the river there was uncovered a crevice in the ledge which enabled salmon to ascend, and they were thus preserved from complete destruction, but shad and alewives never recovered, though there is evidence that shad have sometimes, in small numbers, passed both of the above dams. Very soon after the building of these dams a rapid decline in the fisheries began. The shad fishery was in a few years utterly extinguished. The alewife fishery above Bucksport was also destroyed, no breeding ground now remaining but in Easton River, which alone did not even suffice to prevent deterioration of the fisheries in its immediate vicinity. The salmon continued to decline till about 1860, when their lowest point was reached.

The town records of Orrington afford some data which indicate in a general way the relative productiveness of the fisheries for a long series of years. In 1807 the legislature of Massachusetts passed an act authorizing the town to exercise exclusive control of the river fisheries, and it was

the practice to sell the right to fish annually at auction. There were three sites for weirs, which were all sold when fish were plenty, but in times of scarcity some of them occasionally stood idle. The blanks are understood to indicate, in most cases, a failure to effect any sale. As a record of special interest it is presented entire.

Year.	Rental.	Year.	Rental.	Year.	Rental.
1814	$48 50	1837	$361 37	1859	
1815	63 50	1838	124 00	1860	$1 00
1817	138 00	1839	13 70	1861	2 65
1818		1840	37 22	1862	4 50
1819	85 25	1841	42 70	1863	4 50
1820	150 50	1842	54 85	1864	
1821	68 25	1843	22 25	1865	18 00
1822	12 53	1844	7 69	1866	21 25
1823	15 00	1845	2 47	1867	9 50
1824	157 05	1846	9 61	1868	26 50
1825	210 95	1847	6 30	1869	10 50
1826	359 00	1848	33 15	1870	2 50
1827	410 00	1849	32 72	1871	
1828	492 00	1850	4 04	1872	
1829	440 00	1851	15 25	1873	
1830	445 60	1852	50 50	1874	27 75
1831	530 75	1853	14 62	1875	
1832	481 00	1854	15 00	1876	1 55
1833	171 25	1855	22 62	1877	2 00
1834	40 70	1856	31 38	1878	13 00
1835	144 83	1857		1879	6 00
1836	335 88	1858	7 00	1880	5 00

In 1814 it is probable that the implements employed in fishing were of a very primitive character, and that the same incentives to effort, a brisk demand and the remunerative prices of ten or fifteen years later, did not yet exist. The price obtained in 1829 indicates that the result of the fishery of 1819 was encouraging, but the scanty catch of 1820 and 1821 (which rests on satisfactory direct evidence from other sources) finds its natural result in the sudden dropping off in the bids in 1821 and 1822. The rapid recovery of the fishery is shown by the rise of the rental after 1823. Prosperity continued to attend the fishery till 1832. The result of the fishery that year was evidently disappointing, and the next year the rental fell off 62 per cent., and in 1834 there was a further drop of 66 per cent. from 1833. In this we see the result of the decline of the alewife and shad fishery. The revival of 1835, 1836, and 1837 was, it is fair to presume, the result of the excellent condition of the salmon fishery, which, according to another authority,* was at this time showing an increase, which culminated in 1836. The general decline of the salmon fishery is shown by the falling off of the rental from 1837 to 1845.

Since 1860 there have been various fluctuations in the numbers of salmon and alewives, but the shad have remained steadily at low-water mark. The years 1867 and 1868 were good years for salmon; so also were 1872 and 1873. In 1867 the State commissioner of fisheries estimated the catch, from imperfect data, at 8,000 salmon and 1,000,000 alewives. In 1873, after careful inquiry, the number of salmon caught was estimated at 15,000.† The latter year was beyond question the best since 1860, and probably the best since 1850.

SAINT GEORGE RIVER.—The Saint George is a small river, draining only 210 square miles of territory. Its water surface, however, embraces seventy-two lakes and lakelets, of which the

* Mr. Amos Treat, of Frankfort.

† Rept. U. S. Fish Com. 1872–'73, p. 313.

sixteen largest have an aggregate area of 14.35 square miles. All or nearly all of these were naturally accessible to alewives, and, as may be inferred, the river produced this species in great abundance. Shad and salmon were also found there, and tradition says in plenty, but it does not appear how plenty. At any rate, since the beginning of the present century, salmon have been rare and shad not abundant.

Alewives, smelts, and eels are now caught in this river in sufficient numbers for market purposes; the alewives in weirs in Thomaston and Cushing, and in dip-nets in Warren; the smelts in weirs in Thomaston, in bag-nets under the Cushing Bridge, and by hook in Warren; the eels are taken with weirs, pots, and spears.

The alewife fishery at Warren is controlled by the town. The weir fishery is free. There is also a free fishery with drift-nets, which is believed to be mainly illegal.

The town fishery at Warren dates as far back as 1802, when it was established by act of the legislature of Massachusetts. It was the practice until 1879 for the town to appoint an agent, who, with his deputies, captured the fish and dealt them out according to law. Tickets were issued to heads of families, each ticket entitling the holder to 300 alewives on payment of the fixed price, which was generally 20 cents per hundred. The order of precedence of the tickets was determined by lot. Certain poor were supplied gratis. After all the tickets were supplied, the remainder were sold for the town to any buyer. From these sales large sums were formerly realized, and one year it amounted to $2,300, which paid the town tax for that year, the minister's salary, and left something over. The gradual curtailment of the area of their breeding grounds by the closing of tributary lakes and the difficulty of passing the dams at Warren caused a decline in the number of the alewives. From 1849 to 1858, inclusive, the average amount received from sales was $511 yearly; the best returns being $1,146.16 in 1854, and the poorest $144.25 in 1850. During eight years, from 1859 to 1867, inclusive (excepting 1865, when no sales were made), the average of receipts was $219.87. The lowest ebb appears to have been reached in 1864, when but $65 were received. For some years the fishery continued to yield very little, and in 1873 was almost a total failure. Since then, however, there has been a great improvement, the sales in 1875 amounting to $526.28, and subsequent years having been quite productive. The improvement may be reasonably ascribed in the main to the construction of improved fishways.

The total catch of alewives in 1880 in the river by all methods was 515,000. There were 400,000 smoked and 134 barrels salted.

The smelt fishery of the Saint George is of greater pecuniary importance than the alewife fishery, though its origin dates from no further back than about 1870 or 1868, when several weirs were built for them in the river just below Thomaston. At present there are 8 weirs built on the river, and nearly all the smelts are caught in them. There are, however, 3 bag-nets used at the Cushing Bridge, and a few men fish with hook at Warren. The product is shipped by rail to Boston and New York, the latter taking commonly 80 to 90 per cent of the total. The census year was the best year in the history of the fishery, 95,000 pounds of smelts having been sent to market. The next best year was 1875–'76, when the shipments amounted to a little over 60,000 pounds. In other years since 1872 they have amounted to from 25,000 to 42,000 pounds.

No tom-cods of consequence are caught in this river, and the eel-fishery, followed with pots and a few spears, produces but about 8,000 pounds a year.

MEDOMAK RIVER.—A small river, draining but 62 square miles of territory and less than 3 square miles of lake surface, the Medomak has never been a very important producer of fish. It

was closed to the anadromous fishes by legislative sanction in 1800. At present it has only a few smelts. There is a prospective alewife fishery, the result of the encouragement given this species through the construction of fishways and restricted fishing, but in 1880 the capture of alewives was still forbidden.

The smelt fishery is limited to the operations of 3 weirs built in Broad Cove, and a large number of hook fishermen, of whom about 80 are estimated to have fished for them for sale in cloth huts similar to those used in other places. The total catch in 1879–'80 was 33,910 pounds. The smelt fishery of the Medomak dates from the year 1871, when one George Preble came from the Kennebec and built a weir about 1½ miles below the village on the east side of the river. He met with good success, and the next year two weirs were built. From this the weir fishery suddenly developed itself until the hedges were forbidden by law as impediments to navigation. About 1877 it was discovered that smelts could be taken here with hook, and there was an immediate development of that fishery. The fishing grounds are at various points within 2 miles of Waldoborough village.

PEMAQUID RIVER.—This is a very small stream, having a drainage basin of only some 10 or 15 square miles. An alewife fishery of some local importance once existed here, but it was destroyed by impassable dams and improvident management.

DAMARISCOTTA RIVER.—This is also a small river, having a drainage basin of little more than 50 square miles, and a lake surface of 10 square miles. In the matter of fisheries it is, however, the most important river in the State after the Penobscot and Kennebec. The river has its source in a lake of 10 miles area, known as "Damariscotta Pond," which is fed by many small brooks. From the outlet of this lake to the sea is about 19 miles, of which less than a quarter of a mile is fresh water, the rest being a tidal brackish estuary. From the lake the river plunges at Damariscotta Mills down over a steep rocky descent, at the foot of which it enters Damariscotta Bay, a sheet of slightly brackish water about 2 miles long, which is connected with the lower and salter part of the river by a narrow and rather shallow passage. This bay appears to be especially well fitted for a winter home for smelts and eels, and here all the fisheries for those species are plied.

The alewife fishery is claimed and generally believed to have been in its origin wholly artificial, but there is some evidence to the contrary, and it must be regarded as an unsettled question whether alewives ever succeeded in ascending to the lake before they were assisted by man. This much, however, seems to be established, that if such was the fact the extermination of the original brood (doubtless by dams which were very early erected here) was effected so long ago that its existence was unknown to those living in the vicinity seventy-five years ago. The tradition is that up to 1803 no alewives had ever ascended the falls. A few stragglers came yearly to the foot of the falls and by plying the dip-net industriously a man might get a mess of them, but as they were unable to reach any breeding ground, they did not increase. In 1803, however, some of the citizens got a lot of alewives from Pemaquid River (some say from Warren) and put them into the lake, and when their descendants in due course of time came back from the sea a rude fishway was constructed of loose stones for them to ascend. The result was the establishment of a flourishing fishery. In 1810 the towns of Nobleborough and Newcastle, whose boundary is formed by the river at the falls, assumed control, under legislative sanction, of this fishery, and have continued to manage it down to the present time after the manner of town fisheries in other parts. Until 1865 the fish were taken by the fish committee and sold to the citizens and the public at 25 cents per

hundred. From 1865 to 1880, inclusive, the committee has sold the privilege of taking fish at auction, and the price was in 1866 raised to 50 cents per hundred. Receipts from the auction sales, and the estimated number of fish taken each year, have been as follows:

Year.	Proceeds of auction sales.	Number of alewives taken.
1866	$1,200	700,000
1867	1,900	1,300,000
1868	2,800	800,000
1869	2,040	750,000
1870	2,245	1,000,000
1871	1,875	350,000
1872	1,340	400,000
1873	1,840	600,000
1874	2,040	800,000
1875	2,056	800,000
1876	2,050	600,000
1877	1,845	600,000
1878	2,040	856,000
1879	2,100	737,000
1880	2,100	1,700,000

From this it appears that the best catch since 1865 was that of 1880. But this was sometimes exceeded in the first half of the century. The year 1843 is remarkable as the most productive ever known. The spring of that year was a season of exceptionally large rainfall, and the water in the river was very high. The product of the sales at 25 cents per hundred was about $3,000, and a great many were taken by private parties who did not pay for them.

The above statements refer only to the fishery at Damariscotta Mills, which is managed by the towns, and the implements of which are dip-nets exclusively. There, however, exists a weir fishery of early origin and now embracing 13 weirs on the lower part of the river in Bristol and Edgecomb, a gill-net fishery with about 20 nets in the same vicinity, and a seine fishery at Rutherford's Island. By all these methods there were taken in 1880 about 2,300,000 alewives, or about 5,400 barrels, of which 2,950 barrels were salted, and 2,400 barrels smoked.

The earliest alewives make their appearance in the vicinity of Damariscotta Mills at the end of April or the first of May, and they continue to ascend the stream for five or six weeks. The first captures are generally made from May 5 to 10, and the principal run is expected about May 20 to 25. Of the early runs 400 fill a barrel, but at the close of the season it takes 500.

The smelt fishery of the Damariscotta has sprung up within the last twenty years. It has always been exclusively a hook-and-line fishery through the ice of Damariscotta Bay. In its earliest stages the fishermen stood by their holes without shelter. Then they resorted to clumps of brush to break off the cold winds. The next step was the building of a heavy wooden shanty, and these have finally given place to neat, comfortable, and easily-movable cloth huts, of which in the winter of 1879–'80 there were in use 154—the greatest number ever known. Each house is occupied by one man with 3 lines, and each line generally carries a single hook. The favorite and ordinary bait is the marsh minnow, which is collected in the fall and kept in springs or in pits in house cellars. The smelts bite on either tide, and their movements about the bay are so irregular that the fishermen are unable to agree as to best location for fishing, and the huts are often moved about to find better ground. The catch of 1879–'80 aggregated 70,500 pounds, of which about one-third was sent by sleds into the country in various directions, and the remainder forwarded by rail to Boston and New York. The prices obtained averaged to the fisherman 4½ to 5 cents per pound.

The eel fishery of this river is also located in Damariscotta Bay, and employs no implement but the spear. The product has fallen off some in recent times in spite of a protective law which limits the fishery in point of time to the four months of December, January, February, and March. In 1879–'80 the yield was 18,200 pound.

SHEEPSCOT RIVER.—The Sheepscot drains about 200 square miles. Its tributary lakes are few and small, and it seems to have been, as tradition asserts, frequented by salmon and shad to a greater extent than any other river between the Kennebec and Penobscot, while alewives were relatively less abundant. Impassable dams at Alna, at the head of the tide, have for many years shut the migratory fishes out from nearly its entire course. The main river was exempted from the operation of the fish law by act of legislature in 1800. This exemption did not extend to Dyer's River.

At the present day the fisheries of the Sheepscot are of little importance, the total value of the product being but $2,540, which is about the ninth part of the product of the Damariscotta. About 1,000 shad are taken in traps arranged for them in the river near Alna. One or two salmon are commonly taken in these shad-nets, but none in 1880. No alewives of consequence are caught, there being no fishing specially for them, and no summer weirs built. Bass, smelts, and eels are the species taken for market.

The implements employed in the smelt fishery are 11 weirs, 3 bag-nets, and the gear of about thirty-five hook fishermen. The weirs are built at various points both above and below Wiscasset, and operate in the fall and winter. The bag-nets were set at three bridges, on the tributary known as Back River. The hook fishery is located near Sheepscot Bridge, from half a mile above to 2 miles below, varying from year to year, according to favorable or unfavorable condition and extent of the ice. This fishery dates from the winter of 1876–'77. About $1,000 worth of smelts have been taken out yearly, except in 1879–'80, when, on account of the unstable condition of the ice, there was little fishing done at this point, and the total catch of smelts in the whole river was but about 22,000 pounds, valued at $1,100.

Bass are taken in summer with hook and line at Flying Point, in Wiscasset, and in winter in gill-nets, above Sheepscot Bridge, in both the main river and its principal tributary, Dyer's River—mostly in the latter. This fishery began about 1873, some men from the Kennebec being the first to engage in it. In the channel of Dyer's River, which is here uniformly very narrow and of even depth, they set gill-nets about 35 feet long, 12 to 15 feet deep, and with a 4-inch mesh, through the ice across the channel, which they in general completely span. The bass taken are ordinarily from 3 to 12 pounds in weight, but some of 30 to 40 pounds are now and then caught. The catch of the gill-nets is estimated at 5,000 pounds and of other methods at 3,000 pounds.

Eels are plenty in Dyer's River. They are taken with spears to the extent of about 4,000 pounds yearly.

KENNEBEC RIVER.—The Kennebec is the second river in the State in size, and second in the importance of its fisheries. It drains 5,800 square miles, of which 450 square miles is lake surface. About two-thirds of the basin is covered by forest, and nearly the whole of it is hilly or mountainous. Far the greater part of its volume is contributed by its western tributaries, several of which, the Sandy, Carrabasset, Dead, and Moose Rivers, take their rise in the mountainous district on the western border of the State. The Kennebec proper takes its rise in Moosehead Lake, 155 miles from the sea. This lake is the largest in the State, having an area of about 120 square miles. The sources of some of the tributaries are from 2,000 to 3,000 feet above the sea, but the main river issues from Moosehead Lake at an elevation of about 1,023 feet. As the descent thence to the sea-level is accomplished in the 112 miles between the lake and Augusta, the Kennebec is a very

rapid river. There is very little dead water, the current averaging near 3 miles per hour. Rapids abound, and at several points there are important falls, as at Waterville, Skowhegan, Carritunk, and several points near the lake. Below Augusta there is a 20-miles stretch of water affected by the tides, but which is nevertheless in ordinary summers entirely fresh, ending in Merrymeeting Bay, where the Kennebec is joined by the Androscoggin and by several smaller rivers. From Merrymeeting Bay to the sea the river flows in a narrow channel, and, unlike the Penobscot and most of the other rivers of the State, it discharges into the ocean by a narrow mouth.

The tributaries of the Kennebec are of various character. Some of them are characterized by extensive chains of lakes, and others by long stretches of gravelly rapids. They are nearly all free from serious natural impediments, the most important exceptions being the Mussalunskee (Emerson Stream), draining the Belgrade lakes, which has a perpendicular fall of 38 feet at West Waterville, 8 miles from its mouth, and Dead River, or the West Branch, which has a similar fall of 28 feet, 15 miles from its mouth.

The artificial obstructions to the ascent of the Kennebec and its branches by migratory fishes are numerous and formidable. On the main river there are dams at Augusta, Waterville, Fairfield, Somerset Mills, Skowhegan, and Madison. All of the tributaries are dammed at frequent intervals. On the Cobbosseecontee there are 8 dams within 1 mile of its mouth. On the Sandy there are 3 dams within the natural range of fish, the same number on the Carrabasset; on the Sebasticook and branches 15 or more. The damming of the tributaries dates from the last century. The main river remained open till 1838, when the completion of the Augusta dam shut them out from all waters above that point. Previous to 1838 fishways were maintained on the Sebasticook and some of the lesser tributaries, but no adequate provision for the ascent of fish was made at Augusta until 1879, and meanwhile all the other fishways had been neglected.

In other respects the Kennebec has been less unfavorably affected by the influence of civilization than the Penobscot. Neither river has been polluted with sewage nor the waste of manufactures, and the discharge of sawdust and other mill refuse has been on a smaller scale on the Kennebec, and has not, so far as can be seen, exerted any unfavorable influence.

Salmon.—The original limit of the range of salmon in the Kennebec was probably about 12 miles above the "Forks," or junction of the West Branch, or Dead River, with the main Kennebec, and 144 miles from the sea. On Dead River it was at Grand Falls, 147 miles from the sea. Owing, however, to early sparsity of population very little information on this point has come down to us. The most serious natural obstruction in their way was Carritunk Falls, where they were obliged to surmount a perpendicular fall of 16 feet, and although it is certain that many succeeded in doing so, it may well be doubted whether they constituted a majority. In the Carrabasset and Sandy they ascended many miles from their mouths, and it is supposed that these two rivers afforded their principal spawning grounds. They are known to have ascended the Sebasticook, though only in small numbers, and they are said to have been sometimes found in the Wesserunsett and Cobbosseecontee.

The aborigines doubtless pursued the salmon, but very few facts about it are known. In 1754 a military force ascending the river found a few Indians at Norridgewock, and fresh salmon in their possession. Records of the year 1773 show that salmon in barrels were sent as articles of merchandise from Fort Halifax (near the present town of Waterville) to Fort Western (now Augusta).* It was probably not many years after the latter date that drift-net and dip-net fisheries sprang up at Showhegan and Carritunk. The latter continued to be the best fishing

* North's History of Augusta, page 115.

ground above Waterville as long as salmon were able to pass Augusta. There was at the same time a drift-net fishery of less importance at Augusta, several seine-fisheries, in which some salmon were taken at various points up and down the river, and a weir fishery near its mouth. An eye witness* estimated the number of canoes fishing with drift-nets at Ticonic Falls since the beginning of the present century at about forty yearly, each canoe employing two men and one net. On one occasion as many as eighty-two canoes were counted at work at the same time. These canoes were all log dug-outs. Their ordinary catch was estimated at one hundred and twenty salmon for each canoe for the season, which would give a total of forty-eight hundred. Another witness† estimated the number of drift-nets fishing at Augusta in 1820 at twelve, and their catch at four thousand salmon. These are, however, off-hand estimates, and are liable to be far out of the way. In 1837 and 1838 the dam at Augusta was built, completely blocking the way of migratory fishes, and extinguishing all the fisheries of the upper waters. Of the salmon fishing below Augusta, we know that it was in a flourishing condition as late as 1814, when an old-fashioned shoal-water weir at Abagadasset Point, in Merrymeeting Bay, took one hundred salmon in a single season,‡ whereas in recent years a far more efficient weir on the same spot rarely or never takes as many as half a dozen in a season. From 1826 to 1835 the yield of salmon continued good, though by no means averaging so well as in 1814, which may have been an exceptional year. From 1837 to 1842 there was a decidedly higher yield, which was especially noticeable at Augusta. After this there was a sharp decline, which continued till 1855 or 1860, when the lowest point was reached, just short of utter extinction. The only breeding ground remaining accessible to the salmon was on the gravel beds within the first half-mile below the Augusta dam, and to this opportunity is the continuance of the brood in the river doubtless due. Since 1860 there have been several fluctuations, 1868 having been the best year then known since 1850, and 1873 having been still better. The number taken in 1867 was estimated by the state commission at twelve hundred, but this is regarded by some as too high an estimate. The data obtained by a careful inquiry (but not a thorough canvass) in 1873 led me to estimate the number taken in that year at fifteen hundred, of which nine hundred were taken below Bath and six hundred above that point. In latter years there has been a gradual decline, with some minor fluctuations. The total catch in 1880 was two hundred and sixty-nine salmon.

For the past twenty-five years the fishery for salmon has been little more than an adjunct of the shad and alewife fishery. It is probable that not a single weir would be built or seine operated on the river were it not for the shad and alewives, and the drift-nets at Augusta, the only implements used expressly for salmon, have rarely numbered more than two in a season, and have sometimes been suspended for a whole summer.

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* Mr. William Getchell, who owned an island at Ticonic Falls, and carried on a dip-net fishery there, mainly for shad, from 1804 to 1837, and who was in 1867 still living in Benton.

† Mr. William Kennedy, of Augusta.

‡ The authority for this statement is Mr. John Brown, of Bowdoinham, who was at that time a boy living on the point. Mr. Brown has a daily record of his own fishing, extending, almost without interruption, from 1826 to 1861. With his free permission I draw the following facts therefrom; Mr. Brown's location was not favorable for salmon; no more, indeed, was any part of Merrymeeting Bay. The shad and alewives were the principal fish taken. The average number of salmon taken in his weir during the ten years ending in 1835 was 21.6 yearly. In 1837 there was an increase to 41, a greater number than any previous year since the record began. In 1838 there was a still greater number, 65. The four following years the catch was 46, 27, 49, and 27, respectively, and the average for the six years ending with 1845 was 42.5. This is held by Mr. Brown to show very plainly the effect of the Augusta dam in detaining the salmon, and even impelling them to retrace their course from Augusta toward the sea, at least as far as Merrymeeting Bay. From this time there was a sudden falling off, the average catch for the next five years being but 14. In 1850 it was but 5, the lowest point yet, and in 1855, 1857, and 1858, but one each year, notwithstanding that a more efficient weir had taken the place of the old one.

In early times the salting and smoking of salmon were common, and probably the greater part of the catch was disposed of in this way. Smack vessels from Connecticut visited the Kennebec, as well as the Penobscot, to buy salmon. This was practiced as late as 1814 or later. But since 1825 it has been almost or quite the universal practice to market salmon fresh. The average price received in Bowdoinham in 1826 was about 9 cents per pound; in 1827, 15 cents per pound; and between these extremes it remained until 1845, with the exception of 1834 and 1840. Since 1845 there has been a considerable augmentation.

Shad.—The shad is the most important of the products of the spring fishery, yielding a pecuniary return sixteen times as great as salmon and nearly twice as great as the alewife. It is taken in weirs and drift-nets. Nearly every weir on the river depends more on shad than any other fish, but the most productive shad weirs are those of Merrymeeting Bay and vicinity, which are of the form already described as "shad weirs," whose distinguishing characteristic is the capture of the fish in a large pound of deep water, from which they are taken with a seine. This form of weir is exclusively used in this vicinity, as on the lower part of the river the weir with a board floor is almost the only form in use. The principal reason for the difference in practice of the two sections is the difference in the condition of the river and the currents, a seine-weir requiring a gentle current for its successful operation. The form of weir has doubtless something to do with the fact that four-fifths of all the shad are taken in the Merrymeeting Bay district, including the Androscoggin arm of the bay and its tributaries, but it seems that while in the cooler and saltier water of the Georgetown district they are more inclined to avoid the shores and pass up the river. Of the 140,000 shad taken in the Kennebec in 1880, 108,000 were taken in the Merrymeeting Bay district, 5,800 above Richmond, 16,744 between the bay and Bath, and only 10,000 below Bath, including the Sasanoa or east channel, between Woolwich and Arrowsic. The approximate averages are as follows: In the bay district, 44 weirs averaged 2,045 shad; below Bath, 29 weirs averaged 345 shad. All included in the above statements are the breeding shad, called by the fishermen "river shad," or "spawn shad." The sea shad are mostly taken with drift-nets in the lower reaches of the river, but to some extent in the weirs. In 1880 the catch of sea shad was exceedingly small, and only about 80 barrels were cured. The drifting below Bath is wholly for sea shad; above Bath, for river shad.

In early times shad appear to have ascended the main river to Norridgewock Falls, Sandy River, a few miles from its mouth, and the Sebasticook in small numbers to Newport. Tradition also assigns the shad a place in the fauna of the Cobbosseecontee. There were productive shad fisheries at several points above the flow of the tide, among which we may mention Ticonic Falls (Waterville) and the Lower Sandy River. At Ticonic Falls there is an island in mid-stream, where great facilities existed for catching shad with dip-nets. This island was private property. The proprietor, from 1804 down to the extinction of the fishery, has stated that in the early days of his fishing he used to take $500 to $600 worth of shad yearly. As remarkable feats he mentioned that with the assistance of his three boys he had taken 1,100 shad and 20 salmon in an afternoon, and that one day four men dipped out and hoisted ashore 6,400 large shad. There was a similar but less productive dip-net fishery on the falls at Skowhegan.

The drift-net, seine, and weir fisheries in the tidal waters were very productive. It is in evidence that in 1822 a seine at Augusta was known to take 700 shad in a day; that about 1837 there were about 100,000 shad taken in Eastern River (Dresden) alone. It is known that the shad fishery was by no means uniformly productive. A period of scarcity occurred about 1870. That year the weir at Abagadasset Point took but 150 shad; its catch in after years ranged from 3,000

to 10,000 yearly), and another weir, on the eastern side of the bay, took but a half-hogshead tub full. A drift-net fisherman took but 20 shad. It was thought that shad-fishing was at an end; but the next year the shad were found to be increasing in numbers, and in a few years they were again plenty. The year 1831 was one of the best years ever known in Merrymeeting Bay; a seine at Beef Rock, on the east side of Swan Island, took 30,000 shad.* To what causes to attribute these fluctuations we are unable to say, but they must of necessity have been natural causes. From 1830 to 1836 there were inspected in the three towns of Bowdoinham, Dresden and Woolwich 6,079 barrels of shad, an average of 868 barrels yearly. Inspection of packed and exported shad was compulsory, and it is safe to say that these figures represent seven-eighths of the shad caught. We may therefore estimate the catch in those towns at about 1,000 barrels, or 100,000 shad, yearly. There were at that time only 2 weirs in Merrymeeting Bay, and a few in Eastern River, all shoal-water weirs. The most of the fishing was done with drift-nets in the small rivers, like the Cathance and Eastern, and with 4 or 5 seines. In 1867 in the same district the catch of 40 deep-water weirs, several seines, and an unknown number of drift-nets was about 180,000. In 1880, 44 weirs, 2 seines, and some 60 drift-nets, covering nearly the same district, took about 105,000 shad. It appears, then, that the product of the Merrymeeting Bay shad fisheries is as great now as in 1830–1836; but this catch has been accomplished by the use of a great number of far more efficient implements.† The seine-weirs were introduced in 1851 and 1852, and soon almost entirely replaced the shoal-water weirs. In other parts of the river, where their construction was impossible, the catch of shad has fallen off remarkably since 1830, and the entire fishery of the districts above Augusta was of course extinguished in 1841, when the Augusta dam was finally closed.

Alewives.—All the weirs take alewives along with shad and salmon, and at the present day none of consequence are taken in any other way, the use of drift-nets having been discontinued since 1867, and the fish no longer ascending to places where they can be taken with dip-nets. As with shad, the most productive weirs are those of the Merrymeeting Bay district, especially in Eastern River and the main river on the east of Swan Island, where 7 weirs took, in 1880, 147,820 alewives, an average of over 20,000 per weir. In the bay, north of Abagadassett Point, 15 weirs averaged 12,500; south of Abagadassett Point, including the Androscoggin, Cathance, &c., 22 weirs averaged but little more than 5,300 alewives; between the bay and the city of Bath, 14 weirs averaged about 7,500; below Bath, in the main river and branches, 29 weirs averaged but 1,862 alewives. Thus the catch of alewives increased with distance from the sea in the main river, but fell off in the Androscoggin arm of the bay. The total catch in 1880 is estimated at 675,000. Only 20 barrels (part of the catch of Eastern River) were salted, and 600,000 were smoked.

Perhaps the earliest mention to be found of the alewives of the Kennebec is in a letter of the French priest Rasle, writing from the village of Norridgewock in 1723: "At a particular season of the year," says he, referring to the customs of the natives, "they repair to a river not far distant, where during one month the fish ascend in such numbers that a person could fill 50,000 barrels in a day, if he could endure the labor. They are a kind of large herring, very agreeable to the taste when fresh. Crowding one upon another to the depth of a foot, they are drawn out as if they were water. The Indians dry them for eight or ten days, and live on them during all the time that they are planting their fields."

* Statement of Mr. John Brown.

† Mr. Brown's weir produced in the ten years ending in 1835 an average of 5,961 shad yearly; in the twelve years from 1837 to 1848 (1844 being omitted from the record) the average was 3,120 per year, a little more than half the former yield.

Fifty years later than this the whites had taken posession of the country and began to build saw-mills. They found the alewives ascending the river in immense numbers, extending their migrations to Norridgewock Falls, 91 miles from the sea, and up the Sandy River some 20 miles farther. Their principal breeding places were, however, in the lakes and ponds of tributaries nearer the sea, especially Cobbosseecontee stream (at Gardiner), Seven-mile Brook (in Vassalborough), and the Sebasticook River. The first of these afforded an extensive breeding ground in its 21 square miles of lakes and ponds, and must have contributed an important quota to the population of the river, but it was early closed. In 1787 we find the town of Wales (then including *Monmouth*) appointing a fish committee, which the next year was designated a "committee to see that the fishways are kept open according to law." The dams at Gardiner, however, were impassable, fishways were not maintained, and very early in the present century this brood of alewives was extinguished. A similar fate overtook the alewives of Nehumkeag and Worromontogus streams, two small tributaries on the east side of the river. At Seven-mile Brook and in the Sabasticook the alewives continued to breed until 1837, when the dam at Augusta finally cut them off.

The Sebasticook was probably the principal nursery of alewives for the Kennebec. It has a lake surface of 48 square miles, nearly every mile of which was accessible. After suffering great diminution while running the gauntlet of the tidal fisheries, there still remained a vast throng of fish to attempt the ascent of the Sebasticook. Fishing in this river was at first entirely free to the public, but after some years it was found that there was a diminution in the numbers of alewives, and protective legislation was then obtained for the most important points, which were at the falls, natural and artificial. The fisheries at such places were generally put into the hands of the towns. It does not seem that these measures were entirely effective, but that there was a gradual decline from obstructions and excessive fishing. There was a dam at the upper falls in Clinton previous to 1775, but it was provided with a fishway and the alewives continued to ascend in great numbers as far as Newport, on the main Sebasticook, and to the principal lakes on the tributaries. In 1809 a more formidable dam was put across the river at Benton. A serious falling off of the fish was soon perceptible and the dam was cut away to allow them again to ascend. In 1814 the town of Benton took charge of the fishery under legislative authority, and by a more careful management effected a substantial improvement. The right to take the fish was sold at auction yearly and brought from $500 to $1,500, though under the condition that the poor should be supplied gratis and all townsmen at a set price. The last year of the fishery (about 1837) it sold for $225; one or two years earlier, for $500.

Thus one by one the feeders of the river were cut off, with only one exception, that of Nequasset stream, in Woolwich, which remained open until very recent times, and, indeed, is not regarded now as permanently closed. The breeding ground in the main Kennebec was also largely curtailed, and is now limited to the tidal portions of the river in and above Merrymeeting Bay, and of the small tributaries centering in Merrymeeting Bay. So far as they go, however, these waters are very good nurseries, and in its yield of alewives the Kennebec now stands third among the rivers of Maine, only the Damariscotta and Penobscot surpassing it.

Of the number of alewives caught yearly in early times we are no better able to form an estimate than in the case of salmon and shad. There can, however, be no reasonable doubt that tradition is right in assigning them numbers far greater than has been known to any one now living. There must have been a great decline in their numbers consequent upon the erection of impassable dams across the streams by which they were wont to reach some of their best spawning

grounds. Yet measured by the standard of recent years they were still abundant in 1830. During the ten years ending with 1835 Mr. Brown's single shoal-water weir in Merrymeeting Bay took on the average nearly three times as many alewives as two deep-water weirs in the same vicinity took in the year 1880. The average catch of the same weir for the twelve years ending with 1848 shows a decline of about 40 per cent. In 1867 the State commissioners of fisheries estimated the aggregate catch of the river to have averaged about 1,200,000 alewives for some years previous, there being then eighty-six weirs, eight seines, and a few drift-nets in operation. In 1880, with eighty-seven weirs and two seines in operation, there were taken about 675,000 alewives. The latter estimate does not include bluebacks, of which some 400,000 were taken in 1880, an unprecedented number. The estimate made in 1867 is supposed to include few if any bluebacks.

Smelts.—The capture of smelts in the Kennebec was carried on on a small scale with hook and line and also with small gill-nets as early as 1814. Both these methods were in vogue in Eastern River at that time, and the hook and line fishing was probably common in other parts of the river, especially farther up, but it does not seem that the use of gill-nets was known elsewhere. The use of nets extended to other parts of the Kennebec, and this continued to be the most productive mode of taking smelts until the introduction of bag-nets, about 1852. The most of the smelts taken fifty years ago were for home consumption, but even then there was a small trade in them for the supply of local and inland markets. One cent per dozen is quoted as the price received by a fisherman for his entire winter's catch. About 1850 there sprang up a brisk demand for smelts to supply the large cities, especially New York, which has always taken the greater part of the catch of the Kennebec since that time. The introduction of fykes and bag-nets dates from 1851 and 1852. Both these nets were used in the Kennebec for many years, but the fykes have gradually gone out of use and plain bag-nets taken their places.

With the exception of two nets on tributaries in Georgetown and Arrowsic, the bag-net fishery is confined to the district between Bath and Richmond. There were one hundred and fourteen nets employed in the winter of 1879–'80, and their catch was about one-third of all the smelts taken in the Kennebec.

Weirs for smelts are employed only below Bath, mainly in the mouth of Back River, between Georgetown and Arrowsic. They are half-tide weirs, built and put in operation in autumn, and if not earlier broken down by ice they fish until the smelts are all gone past up the river, which varies from year to year, but averages about the middle of January. The total product of the fishery in Georgetown and Arrowsic in 1879–'80 was about 52,000 pounds.

The hook fishery is carried on in two districts: first, in the Sasanoa, at Preble's Point (the northern extremity of Arrowsic); second, in Gardiner and Hallowell. The latter locality is an old one, having been occupied with little or no interruption, though with all degrees of success, from very early times. About 1850 it was very productive, but, according to local testimony at Gardiner, it has fallen off greatly since the introduction of bag-nets in the Bay district. In 1879–'80 there were about a hundred persons who fished for sale, but not more than a dozen followed it persistently; the aggregate catch was about 19,650 pounds, all of which were disposed of in local markets. The fishery at Preble's Point has just sprung into existence, the discovery that smelts could be caught here having been first made in the winter of 1878–'79. The next winter there were one hundred and fifty men, with 50 cloth-houses and 350 lines, at work most of the fishing season, and their catch is estimated at 45,514 pounds of smelts.

Eels.—This fishery in the Kennebec, as in most other rivers, has been carried on very irregularly, and little can be said of its history. Eels have been marketed from the Kennebec from very early times. About 1840 a fishing smack from New London, Conn., followed for several years the

business of buying eels in the Kennebec at one cent per pound and carrying them alive to New York. At present, though followed by a few persons at other points, it is mostly confined to Phippsburg, Georgetown, and Dresden. In Phippsburg and Georgetown there is a summer fishery, with traps and pots, employing a portion of the time some fourteen men and yielding 28,000 pounds of eels, of which about half were shipped "round" (packed alive in barrels with ice), and the rest dressed, nearly all to New York. The fishery at Dresden is a winter fishery, conducted on the ice with spears by some twenty men, whose catch, however, is only about 4,000 pounds. The only other eel fishery worthy of mention is an autumn weir fishery at Gardiner, in the Cobbosseecontee stream. The catch here consists solely of gravid female eels on their way to the sea. The proprietor, Mr. W. H. Spear, has sometimes practiced transferring the young eels found so plentifully in early summer in the Kennebec to the lakes above, hoping thereby to increase his catch.

Sturgeon.—All essential facts with reference to the sturgeon fishery of the Kennebec are stated above in connection with the description of the natural history of the sturgeon and modes of catching it. The catch of 1880 is estimated at 250 sturgeon, weighing 12,500 pounds.

Striped Bass.—The principal points in the bass fishery of the Kennebec have already been stated (see p. 693). The only modes of fishing expressly for bass that have been employed on the Kennebec are the stop-net above described, and a floored weir, of which latter method only a single example has come to our knowledge, a weir having been built expressly for bass in 1880, just below Merrymeeting Bay. Bass were once plenty in the Kennebec, but there was at that time little demand for them. Now they are in demand, but are unfortunately scarce. The catch of 1880 is estimated at 12,760 pounds.

Tomcod.—This fish is little prized in the Kennebec, and is now taken only as an incidental product of the smelt fishery, except those captured with dip-nets and grapples at Augusta in midwinter, which are estimated for the winter of 1879–'80 at 40,000 pounds. The quantity taken in the smelt fishery is estimated at 60,000 pounds. The greater portion of these are fed to animals, but the best of them are selected and sold for human food.

Blueback.—The fishermen of the Kennebec almost without exception distinguish the blueback (*Clupea æstivalis*) from the true alewife (*C. vernalis*). As a rule the former is not cured or marketed in any way, but is sold for bait to passing fishing vessels or thrown into the refuse heap. Occasionally, however, some of them are smoked and sold as alewives. The number taken in the Kennebec in 1880, estimated at 400,000, was much larger than ever known there before.

ANDROSCOGGIN RIVER.—The Androscoggin ranks in size as the third river of Maine, draining 3,600 square miles, of which 2,750 are within the State limits. Its aggregate lake surface is 213 square miles, but very little of this was ever accessible to migratory fishes. Its sources are in the mountainous region of Western Maine and Northern New Hampshire. Its upper waters are more elevated than those of any other river, and its descent to the sea steeper. It abounds in gravelly rapids and so far as accessible afforded in early time excellent breeding ground for salmon. The highest point reached by salmon appears to have been Rumford Falls, a little more than 100 miles from the sea, where a natural fall prevented their further progress. It is matter of direct testimony that a few salmon were taken here about 1815, and of tradition that they were abundant here and in Swift River, a near-by tributary, at an earlier date. Probably, however, the falls at Lewiston was always a serious impediment to salmon, being quite impassable to shad and alewives. Salmon are known to have been caught at Lewiston as late as 1815. They were finally shut out by a dam at Brunswick. Alewives used to breed in Sebattus pond, and shad in the main river below Lewiston. Neither of these species has ascended farther than Brunswick for many years; consequently they are reduced to exceedingly small numbers.

The recent fishery of the river is confined to the tidal portions, within 6 miles of its junction with the Kennebec, in Merrymeeting Bay, where a few shad, alewives, and sturgeon are taken. For convenience these fisheries are regarded as part of those of the Kennebec River, and have therefore been included in the remarks on that river.

CASCO BAY AND TRIBUTARIES.—This district possesses no river fisheries of great value, the aggregate product being estimated at $5,609. The species caught, arranged in order of their pecuniary importance, are as follows: Smelts, shad, eels, salmon, tom-cods, alewives.

The smelts are mainly taken in weirs, of which there are 25; located in New Meadows River, 4; in Harpswell Sound, 2; in Middle Bay, 2; in Maquoit Bay, 3; in Freeport, 1; in Yarmouth, 6; in the Presumpscot River, 2; in Portland Back Cove, 3; and in Portland Harbor, 2. In this district (in New Meadows River and Freeport) there are also four smelt seines in use, the only ones in the State. The smelt fishery of this district is of very recent origin, none of the weirs dating back more than twelve years.

The shad taken here are nearly all sea-shad, and are probably immature fish belonging to the brood of the Kennebec. They are mostly taken in drift-nets, which are plied in New Meadows River, Quohog Bay, Harpswell Sound, Middle Bay, Maquoit Bay, and some other localities. Middle Bay has been the best ground. This fishery has been carried on for nearly thirty years and possibly longer. During the past twenty years it has greatly declined. The product is salted and marketed as mess-shad.

The principal eel fishery of this district is in Quohog Bay, where there was discovered in 1876 a most remarkable eel-bed, the most productive ever known in the State. It extends over about 10 acres, on a muddy bottom, without grass, at a mean depth of 13 feet at low tide. The eels are taken out by spears worked through holes in the ice, which commonly forms here in December. The first and second winter from its discovery this bed yielded 2 tons of eels a day for the first five or six days of fishing. Eels are taken in many other localities around the bay with spears, and in the Presumpscot River and around Portland with pots or baskets.

The salmon taken in Casco Bay are believed to belong to the Kennebec River, with few exceptions.

The only tributaries of Casco Bay large enough to demand notice are Royal's River (Yarmouth) and the Presumpscot. Royal's, though a very small river, was frequented by salmon regularly and in considerable numbers at the beginning of the present century; but they have long been shut out by dams, and the last seen were caught in a weir more than twenty-five years ago.

The Presumpscot drains about 520 square miles of territory, and among its tributaries are lakes with an aggregate area of 90 square miles. Lake Sebago, the second lake in the State in size, lies but 22 miles from the sea, but has an elevation of 247 feet. The Presumpscot is therefore a rapid river. It has remarkably clear water, and abounded naturally in gravelly rapids. It was frequented by salmon, shad, and alewives, but seems to have been best adapted to salmon. All fisheries were practically extinguished early in the present century by a dam at the head of the tide. That dam was afterwards abandoned, and alewives have since found a limited breeding ground, and though unable to ascend the river far, both shad and salmon have occasionally been found in it in recent years. All the dams now on the river, some seven in number, have been recently provided with fishways, through which alewives do, and salmon may, ascend to Lake Sebago.

SACO RIVER.—The Saco drains an area of 1,400 square miles, of which 600 square miles lie in the State of New Hampshire, including the greater part of the White Mountain region. Its sources are therefore more elevated than those of any other Maine river. Probably half of the

entire basin is covered with forest. Its lake surface measures 46.8 square miles. A much larger proportion of its basin is occupied by sandy and gravelly land than any of the larger rivers of the State, a circumstance that doubtless contributes largely to the constancy of its flow. The main river is deep, not a single ford existing within 100 miles of the sea. The tributaries, however, afford many gravelly shallows adapted to the requirements of salmon as spawning ground. Several natural falls of considerable height oppose the ascent of anadromous fishes. The first, at the head of the tide, seems to have prevented the ascent of any but salmon, which were able to surmount all obstacles as far as Hiram, 45 miles from the sea, where they encountered an insurmountable obstacle in Great Falls, about 80 feet in height. Below this point they had access to the Great and Little Ossipee Rivers, tributary to the Saco on the west side, in which they are believed to have found their best breeding ground. Tradition asserts their ancient abundance, but that had passed away more than ninety years ago, and at no time within seventy-five years have they been so abundant that a man could take more than five or six in a day with a dip-net at Saco Falls, the principal fishing place known to Saco tradition. The latest date of the capture at Salmon Falls, 16 miles from the sea, was in 1845, and since 1850 they have been practically extinct, but in recent years occasional specimens are taken with dip-nets in an illegal and surreptitious way at the Saco and Biddeford Falls.

Shad and bass have been taken in the tidal portion of the river in recent times, and both were much fished for in 1860. In 1867 gill-nets were in use for shad and several men found occupation in the fishery, but it has since been abandoned. Several nets are still in existence and occasionally set, but not regularly. Alewives are sometimes dipped, but not regularly, nor in any considerable numbers.

The smelt fishery is the only one regularly followed. The only method employed is that of hook and line, plied under the shelter of a movable house on the ice. The favorite location is about 2 miles below the falls, and the fishing is done mostly by night, the houses being lighted by kerosene lamps and heated by small coal stoves. The largest and best houses use six lines each. Some twenty-five men engage in the business. Their aggregate catch is estimated at 6,250 pounds of smelts in the winter of 1879–'80, and they received better prices than the fishermen of any other locality, owing to the superior size and quality of the smelts.

MOUSAM RIVER.—This small river, about 24 miles long and draining about 120 square miles of territory, runs for nearly its whole length through a sandy country, and its water is very pure. At its head is Mousam Pond, a body of water covering about 3 square miles. The Mousam was anciently frequented by salmon, shad, and alewives, and salmon were at one time very plenty. The salmon were exterminated many years ago, and though a few alewives and shad yearly enter the river, there is no fishery for them nor for any other river fish at present existing.

YORK RIVER.—The extreme length of York River is about 12 miles, and its basin has an area not exceeding 50 square miles. Of its early history no facts have been learned. At present it is the site of a small smelt fishery employing two bag-nets and producing 3,000 pounds of smelts in a year.

PISCATAQUA RIVER.—The drainage basin of the Piscataqua, which forms the boundary between Maine and New Hampshire, has an area of 550 square miles, of which 240 square miles is in the State of Maine. Its lakes, having an area of 16 square miles, are thoroughly utilized as reservoirs for extensive mills at Great Falls and Salmon Falls. At the latter point the main river (here called Salmon Falls River) is hopelessly obstructed against the ascent of anadromous fishes, and the principal tributaries are in nearly the same condition. The main upper waters are believed

to have been inaccessible for nearly two hundred years, so that the very tradition of their presence has become dim. It is, however, beyond question that before the obstruction of the river the principal anadromous fishes, especially salmon, were very plenty. Salmon have continued to show themselves occasionally in the river to within forty years. Shad and alewives held on much better, and considerable numbers of both were taken twenty years ago, but since then have greatly declined, and at the present time the attempt to catch them is almost wholly abandoned. Two or three small weirs yielding a very small number of shad and alewives are still maintained on the New Hampshire side of the river. The fishery on the Main shore in 1880 was reduced to a half dozen smelt weirs, whose united product of smelts, tomcods, bass, eels, and perch was valued at $965.

5. LAWS RELATING TO THE RIVER FISHERIES OF MAINE.

THE COMMON LAW.—The common law, as interpreted and applied by the Maine courts, makes a broad distinction between navigable and unnavigable rivers. In the former category are placed all rivers and parts of rivers in which the tide ebbs and flows; in the latter all in which the tide does not ebb and flow.

In navigable rivers, as thus defined, the riparian proprietors own the soil from high-water to low-water mark, excepting cases in which the distance between the two marks is greater than 100 rods, and in these cases they own to the 100-rod limit and no farther.* This title to the soil carries with it the exclusive right to erect fixtures for fishing or other purposes, or even to make a net fast to the shore or bottom within the 100-rod limit; but does not include any exclusive ownership in the water covering the flats, nor in the fish that may swim in it, nor any exclusive right to use a movable net or other apparatus for catching fish, nor does it include any title whatever beyond the 100-rod limit. The public, on the other hand, have not only a right, on equal terms with the riparian owner, to fish in the deep water and on the flats beyond the 100-rod limit, but also the right to take fish with movable apparatus in the water over the soil of the proprietor even up to high-water mark.†

In unnavigable rivers the title of the riparian owner is held to extend to the land under the water from each shore as far as the middle of the stream, carrying with it the exclusive right to fish by any mode in the water covering this land, the public rights being limited to the privilege of passing with boats and other craft, and to float timber up and down streams of suitable size. In the case of fresh-water lakes and natural ponds of greater area than 10 acres, the law of Maine is founded upon that of Massachusetts,‡ and the exclusive rights of the riparian owner extend only to high-water mark.

Thus we have in fresh-water ponds and lakes a fishery with movable apparatus in the hands of the public, in non-tidal rivers an exclusive fishery with movable apparatus in the hands of the riparian owners, and in tidal waters both the same free fishery with movable apparatus and a fishery with fixed apparatus in the hands of land-holders. The law on these points is sufficiently clear, but custom does not in all points agree with the law. Neither have the riparian owners on the non-tidal rivers enforced their rights against the public, nor the public against the riparian owners on tidal waters. In the former case the public has always enjoyed, and now enjoys, the privilege of free fishing with movable apparatus, which is alone allowed by law in those waters; and in the latter the riparian proprietors have maintained an exclusive fishery with fixed apparatus in the waters in front of their respective estates, not merely on the shores laid bare by

* This modification of the common law springs from Massachusetts colonial ordinances passed in 1641 and 1647.

† According to decision of the courts even the digging of clams on flats which are private property is held to be a public right.

‡ An ordinance of 1641 decreed free fowling and fishing in all such great ponds.

the retreating tide, but beyond low-water mark as far as it is found practicable to extend their structures from the shore, in many cases to the maximum depth of 20 feet at low water.

STATUTE LAWS.—All of these fishing rights are held subject to the regulation of the legislature, which has not been backward in exercising its power. During the sixty years of the separate existence of the State of Maine, the legislature has passed 433 acts relating to fisheries, of which 11 were of a general character, 51 related to the sea-fisheries, 161 to the anadromous fishes, 159 to fresh-water fishes, 7 to shell-fish, 22 to the inspection of fish products, 7 to fish culture, and of 5 the precise bearing was not ascertained. In addition to this mass of legislation, we are able to cite at least 48 acts of the legislature of Massachusetts having special reference to the river fisheries of Maine, besides other acts of a more general character which were also in force in the "district of Maine." Of the 433 acts passed by the Maine legislature, there were 114 passed between 1821 and 1840, inclusive; 74 from 1840 to 1860; 245 from 1861 to 1880. Of the 161 acts relating to the anadromous fishes, 71 were passed in the first period of twenty years, 29 in the second period, and 61 in the third period. Of the acts relating to the inspection of fish products, 14 were passed in the first period, 3 in the second, and 5 in the third.

The aims of legislation on the river fisheries have been: first, the preservation of the supply of fish; second, the harmonizing of conflicting interests; third, the prevention of fraud in the sale of fish products. The first object was attained by provisions compelling the removal or abatement of obstructions, especially by the construction of fishways, and by a great variety of provisions touching the time, mode, and extent of fishing. The second purpose was prominently in view in the framing of many of the special laws instituting town fisheries in which all the citizens should have an interest, and was often influential in provisions that restrict certain methods for the benefit of others. And to the prevention of fraud in sale of products was devoted a long list of enactments relative to the inspection of dried and pickled fish.

In the matter of the construction of fishways it has been the uniform policy of the State to require the owners of dams to construct and maintain them. The courts have rendered repeated decisions affirming the principle that "every owner of a mill or dam built it under the condition that a sufficient passageway be allowed for the fish, and the limitation, being for the public benefit, is not extinguished by any neglect to compel compliance." Provision for the enforcement of this rule of law has constituted a considerable part of the legislation on the fisheries for salmon, shad, and alewives. A heavy penalty has been attached to a breach of the law. At times the dam-owners have been left to devise for themselves such contrivances as they might, and at other times officers have been appointed, and charged with the duty of deciding the plan and location. Sometimes, as in a general act passed in 1741, there was provision for the appointment by a court of justice of committees to inspect dams and decide all questions as to fishways. In 1786 it was left to committees chosen by the towns. Early in the present century the county commissioners were assigned this duty in cases not governed by special acts, of which, however, there were very many, covering the majority of the rivers and giving fishway questions into the hands of the local officers. Since 1868 the State commissioners of fisheries have had jurisdiction in such matters, with power to order fishways built or repairs made at their discretion, in all cases serving formal plans and specifications.

The prominent provisions of legislation relative to time and modes of fishing are: the maintenance of yearly and weekly close-times; the limitation of length of nets and other apparatus; the prohibition of fishing near fishways.

The yearly close-time for salmon, shad, and alewives has generally begun from the first to the last of July (sometimes as early as June 16 for shad) and extended to December. At the

present time the close-time for salmon, shad, and alewives begins July 15 and extends to the first of the next April, rod-fishing being, however, allowed from July 15 to September 15. The weekly close-time that has been generally maintained has been from sunrise on Saturday to sunrise on Monday.

Nets and other apparatus were early limited in length to one-third of the width of the stream or water where used. At present they may not, except in the Penobscot River, occupy more than one-eighth the width of the channel, nor shall fixed apparatus extend more than 100 feet beyond the line where there is a depth of 2 feet at low-water.

Early laws exempted but a very small area, 3 or 4 rods from a fishway, from fishing, but since 1868 the limit has been removed farther and farther until now it is fixed at 500 yards; but there are many exceptions in small rivers.

The foregoing remarks have reference especially to the fisheries for salmon, shad, and alewives. About other anadromous species there has been little legislation. Smelts are protected by a yearly close time, from April 1 to October 1, dip-nets being, however, allowed from April 1.

The earliest provisions relative to the inspection of fish products applicable to Maine appear to be contained in a colonial ordinance of Massachusetts of the year 1652, which, after rehearsing the injurious effects on colonial trade resulting from the fraudulent practices of some dealers, provided for the appointment of "viewers," who should scrutinize fish at the time of their delivery by the seller to the buyer, and decide whether they were merchantable or not. Only dry salted fish appear to have been included. In 1692 a much more comprehensive ordinance was passed, in which provision was made for the size of casks, the appointment of "gaugers and packers" in every town where necessay; the inspection of goods packed to see that they are of good quality; the marking of the cask with the brand of the "gauger and packer"; the infliction of penalties for the infraction of the laws, &c. Similar provisions have remained upon the statute book until the present time. Inspection is compulsory, and penalties attached to its omission, or to the exportation of unpacked fish. If the goods are found by the purchaser or consumer to be otherwise than as represented by the brand, damages can be recovered of the inspector.